COLUMBIA LIBRARIES OFFSITE
AVERY FINE ARTS RESTRICTED
AR01408860

A Study... An Information System for Urban Planning

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Robert C. Weaver, Secretary
Washington, D.C. 20410

"The great expansion of our urban areas over the last two decades has too frequently been carried out in a sprawling, space-consuming, unplanned, and uneconomic way . . . . If the taxpayer's dollar is to be wisely used and our communities are to be desirable places in which to live, we must assure ourselves that future growth takes place in a more orderly fashion."

Lyndon B. Johnson

This report was printed earlier as "Urban Planning Bulletin No. 1 -- An Information System for Urban Planning" by the Housing and Home Finance Agency, Urban Renewal Administration.

Avery Architectural and Fine Arts Library
Gift of Seymour B. Durst Old York Library

AN INFORMATION SYSTEM
FOR
URBAN PLANNING

Prepared for

The Maryland-National Capital Park and Planning Commission

By

Robert D. Campbell, Ph.D., Professor of Geography
Principal Investigator

and

Hugh L. LeBlanc, Ph.D., Associate Professor of Political Science
Senior Scientist

The Urban Planning Data Systems Project
The George Washington University

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402 - Price 50 cents

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Division of Metropolitan Development, Washington, D.C.

The HUD Technical Series is designed to make widely available those publications that can contribute significantly to the solution of urban planning problems.

Knowledge of automatic data processing is invaluable for urban development specialists today. This is particularly true in metropolitan and highly urbanized areas, where the collection and use of statistics and other information for decision-making can be enhanced significantly through the use of computers.

"An Information System for Urban Planning" was completed in 1962 by the Maryland-National Park and Planning Commission. It was part of a planning program assisted by an Urban Planning Grant made under the provisions of Section 701 of the Housing Act of 1954, as amended.

We think this study is important because it clearly outlines the steps to follow in the development and use of a data system. Although the study is four years old and is somewhat obsolete with regard to specific techniques (e.g. current use of random access and tapes instead of the card decks discussed in the study), it is helpful as a basis for the initial development of new data systems.

Individuals and agencies considering information systems may also be interested in the "Standard Land Use Coding Manual." This is a joint HUD-Bureau of Public Roads publication which provides a standard coding system for use in information systems, and will be utilized in the Maryland-National Park and Planning Commission's data system. The Manual is available from the U.S. Government Printing Office, Washington, D.C. 20402 for 50¢.

Two other studies relating to information systems are of interest. The results of an information systems experiment involving five metropolitan areas is contained in a report titled "Metropolitan Data Center Project." This report is available free of charge from the Tulsa Metropolitan Area Planning Commission, 600 Kennedy Bldg., Tulsa, Okla. 74103. A study to review and evaluate the major automated systems that have been used for comprehensive planning and programming is now in process under a commercial contract assisted with a grant under the Urban Planning Research and Demonstration Program. This report should be completed during the spring of 1967.

Charles M. Haar

Charles M. Haar
Assistant Secretary for
Metropolitan Development

504

PREFACE

For the past year members of the faculty of the George Washington University have been studying the information problem faced by a suburban planning agency. The study has been supported by the Maryland-National Capital Park and Planning Commission, aided in part by an urban planning grant from the U.S. Department or Housing and Urban Development. Four interim reports have been submitted to the Planning Commission staff. This publication is the final report of the project.

The study has created opportunities for many stimulating discussions with a wide variety of people -- planners, city and county officials, engineers, data processing experts, to name a few. Almost without exception people seem to have been interested in this problem, and there have been so many helpful suggestions that it is impossible to thank everyone properly. However, some people deserve particular mention. Mr. George Allen, Chief of the Research Branch of the Commission, has been especially cooperative and understanding; he is perfectly at home with both professional planner and university professor and has helped us in many, many ways. Mr. Bruce McDowell, Assistant Planner on the Commission staff, had already studied the data processing problem and passed on all of his experience to us. Mr. Albert Merritt, Chief of the Equipment Division, U. S. Naval Photographic Center, introduced us to the possibilities of automation for visual materials. Dr. Harold Bright, Chairman of the

Statistics Department, The George Washington University, solved our statistical problems. Mr. Gordon Morgan and Mr. Joseph Fennell, both of the Logistics Research Project of The George Washington University, put our family characteristics survey data on cards and tape and programmed its analysis on the "1401". Dr. Harland Westermann and Dr. Tait Davis, both members of the Geography Department, The George Washington University, took part in many of the discussions during which the structure of the system was developed. Mr. Eldon Miller and Mr. Lynn Carroll, doctoral candidates at The George Washington University, ably helped by Mrs. Carroll, edited all of the copy, designed and drafted the various maps and figures, including the cover, and typed the entire manuscript. The authors greatly appreciate the exceptional interest they took in doing this task carefully and tastefully.

Robert D. Campbell
Hugh L. LeBlanc

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

CHAPTER 1. INFORMATION SYSTEMS

An information system is simply an organized method of using data for a specific purpose. There are many kinds of information systems, from the notes a doctor keeps on the condition of each patient to the complex array of automatic devices by means of which census data are maintained. Obviously, these two kinds of systems are not interchangeable. The average doctor will certainly not require computers with large memories, and the average census bureau cannot record its data on three by five index cards. Obviously, too, although both systems concern people, they do not contain the same kinds of information, nor are they used for the same purposes. But if the two systems are effective, each in its own way, they are equally "good" or "useful". The test of an information system is not how it works but how well it works. The structure and form of an effective information system will therefore depend upon an understanding both of the uses to which its information will be put and of the basic characteristics of information systems. There is nothing very complex about the basic traits of information systems. However, when people learn an activity involving information they usually learn a specific information process with it, and because of this initial "bias" there is probably not as wide an appreciation as there might be of the flexibility and adaptability of information processes.

THE INFORMATION PROCESS

For many human activities information is basic to decision-making and to action. The information process which supplements and supports such activities is quite simple. Its first step is acquiring information (collection). Information which has been collected must be kept somewhere (storage). And information is not very useful unless it is used, a process which sometimes involves not only getting it out of storage (retrieval), but frequently means interpreting it as well (analysis). Collectively, these steps are referred to, somewhat redundantly, as data processing.

Collection

To collect information one must first translate one's observations into a transferable, transmissible, comprehensible form. For example, the phrase "30 men" is information gained by observation and translated into language. The forms of language in this case are number and words, but the idea could also have been presented with a picture. Identical information can be portrayed by all three language forms, and each form may have a particular utility for a particular information use.

All three forms are susceptible of a wide variety of methods of transmission -- for example, by sound, by one system or another of writing, by many types of electrical impulses, etc. This adds up to a really remarkable diversity of translation and transmission patterns and combinations, particularly when one realizes that the information collector may vary from a highly-trained to a slightly-trained person, from a simple camera to an elaborate electronic sensing device. In other words, there are many collection systems one can use. It is important to choose the one best adapted to the uses to which the information will be put and best coordinated with the other phases of data processing.

Storage and retrieval

To be really useful, information must be kept in a state of ready accessibility. In other words, storage and retrieval should

be two equal elements of the same problem. Unfortunately, this is too often not the case. Librarians "lose" books on their shelves because of classification systems that do not work efficiently. Map custodians file their large, unwieldy blocks of valuable information in almost inaccessible files, sometimes identifying only the drawer and not the fifty individual maps inside it. Ridiculous as it sounds, it is sometimes easier to "recollect" original information than to retrieve collected information from its storage place!

The secret of effective information storage and retrieval is not in the development of new and better and faster mechanical gadgets. Engineers and technologists have designed, and manufacturers have built, a tremendous variety of storage and retrieval devices for most uses. The secret of proper storage and retrieval is, first of all, identification of the information. In other words, information must be classified for use. In automatic storage devices, this is called coding. The important things about classification and coding is to make the information available in a form appropriate to its probable use. A simple example will illustrate this. In a home library, books may be put just anywhere on the shelves: the retrieval system involves either remembering where one put the book or asking who had it last. In a research organization's library, books may be arranged on the shelves according to their pertinence to current research projects. In a small public library with "open shelves", such broad categories as "fiction", "science", and "biography" may be used, and within these an alphabetic arrangement. In a very large library, books will probably be arranged on the shelves according to accession number. That is to say, book number 1,392,000 will be next to book number 1,392,001, although their subjects may be nuclear physics and theology: the object here is to be able to retrieve the book in the simplest possible fashion.

It is not necessarily the case that information will be collected and stored in the same form, although the more nearly these processes coincide the more efficient will be the process. For example, information may be collected in the form of words or pictures, and these may later be identified by a system which is translated into numbers (coding) and stored on punched cards or magnetic tape. However, if the translation to a numerical code can take place at the collection stage, one mechanical step in data

256-721 O - 67 - 2

processing is eliminated (and one chance of error!). Every piece of information in a given system should be identified for storage in such a fashion that it can be retrieved in terms of every other piece of information.

Obvious, but nonetheless important, is the axiom that information used most often is information that should be most accessible. For this reason telephone books are placed near telephones, and dictionaries are standard equipment on secretaries' desks.

Analysis

Information is collected for many purposes, but the most important purpose is to advance human understanding. Man answers questions, solves problems, enlightens issues by his study of relationships, patterns, and sequences in information. An information system cannot do these things for him, but it should offer him the maximum possible help by doing for him the simple and tedious tasks of data processing and by putting information before him in ways designed to heighten and brighten the intuitive processes which he alone can provide. Quantified data must be computed, and unless the computations are very simple, this work should be done by machines. Some data have spatial characteristics and are best collected and stored visually. These data should be retrievable and presentable in all of the ways which can be thought of to stimulate the visual imagination and appreciation. The ultimate goal of data processing is to be a dynamic adjunct of the process of analysis. Every phase of an information system ought, then, to be geared to the probable forms of analysis that will be used.

"RULES" FOR AN INFORMATION SYSTEM

The development of an information system depends upon a series of judgments, ranging from how much information to collect to how much accuracy one demands of the collection process; from whether one will include a particular class of information to the way in which that class of information will be identified if it is included; and from whether or not to use a machine to which

machine to use. A number of "rules of thumb" were set down to aid in such judgments on this project. They are relatively simple; they are not intended to be inclusive; but is is amazing how often they were helpful!

(1) The system will contain no information for which there is no known use. The most deadly and contagious disease of information systems is data congestion. The urge to get corollary information because it is available -- and then not to "waste" it -- must be firmly controlled. An information system is here defined as an organized method of using data for a specific purpose. There is simply no way of making judgments about whether to include classes of information which are not either known to be or strongly suspected to be pertinent. In any case, further information can be -- and usually will be -- added to a system as the orderly process culminates in an analysis which identifies its need. (Hopefully, at this point also needless information can be removed.) The question, "How will this information be used?" should always precede its collection. Otherwise there is no way of knowing that it should be in the system. Perhaps almost a corollary of the first rule is the second one.

(2) Only as much of a particular class of information as is needed will be put into the system. The second most common disease of information systems is over-collection. It does not make sense to collect as much as possible of a given kind of information when a 10% sample would serve the purpose without compromising quality. This is admittedly a complex concept and, for many people, a difficult concept to accept; some large business firms do their accounting on the basis of the "universe" of information, and others use the sampling process. Statisticians claim that the only real difference -- in otherwise equal situations -- is that the sampling process is much less expensive. This is important. More often than not the most expensive element of the information process is collection, and because of the cost involved it is all too often the case that problems are attacked with no information, or with grossly inadequate information, or with information that does not "fit" the purpose. This concept of "fit" introduces the third rule.

(3) The way information is used will determine the way it is put into the system. In simplest form, this rule means that

information that is to be counted will be collected and stored in number language, information that depends upon visual representation will be collected and stored in picture language, and information that can best be verbalized will be stored in word language. It is sometimes the case that the same information needs to be put into the system in more than one way to serve different purposes; in the planning process land use information is an example of this need. This rule has many implications. It means, for example, that information which has already been collected, but in a form not really adapted to one's purpose, ought not to be put into the system in that form. For example, census data have been "made to fit" all types of information requirements simply because of the assumption that no one but the Bureau of Census has the resources to collect demographic information. If the human activity which requires the information system is important, and if the decisions and actions based upon data processing are important, then it should be equally important to use the data properly.

(4) The frequency with which information is needed will determine its accessibility in the system. The "telephone book" principle simply cannot be ignored in an effective system. Classification and coding in machine systems often becomes so complex that this principle is ignored in favor of ease of collection, or "tidy" coding. But the data that are used most often ought to be most available, even if this means duplicating them and keeping them "on top of the desk".

(5) New information will be put into the system as often as is necessary. Information systems can vary all the way from being relatively static to frenetically dynamic. The information sent out by a stock exchange is an example of the latter, and for most of the uses to which it is put the user wants "up-to-the-minute" information. For some purposes demographic information collected every decade is adequate, but for other purposes it is not. Extrapolation of such census data is also quite adequate for some purposes and not for others. How often new information is injected into the system depends entirely upon the uses to which it is to be put.

(6) The system should work just as effectively next year as this year. Classifications should permit both internal changes

and expansion, and such changes should not make current storage files obsolete. The entire system must be keyed to an element or elements so basic as to furnish stability for the system for the foreseeable future. (In the planning process this element is location.)

(7) A new information system should be coordinated as fully as possible with existing information systems. If two people or two agencies need the same information (and its use is not competitive in a free-enterprise economy) it is senseless to duplicate the collection effort. It is the case that cooperation of this sort is not common in American society, whether at the level of the individual, the business firm, or the public agency. Unquestionably the era of greater cooperation has been launched, however. And it has been launched by the use of information processing methods which require expensive machine installations. The use of similar machines will eventually mean a greater similarity in the general construction of information processes -- and greater convertability. But inevitably cooperation of this sort means making adjustments in one's information process -- adding new pieces of information, making changes in a classification system to increase its scope, or changing the collection procedure. And almost as inevitably it also means not only getting a great deal more information for a small increase in effort, but also getting new insights into one's problem. Coordination seems always to be worth many times the effort.

DEVELOPING AN INFORMATION SYSTEM

The choice of "components" of a data processing system for any particular purpose is a matter of knowing the purpose and relating the information process to it. Planning can be described as a process. Creating an information system for urban planning then becomes a matter of "wedding" the two processes, keeping in mind the characteristics of both.

CHAPTER 2. INFORMATION FOR URBAN PLANNING

The information system described in this report was designed to provide data specifically useful to urban planners. Fortunately, urban planners know what they are trying to do. They are also generally agreed about the methods by which they are trying to achieve the goals of planning. It is therefore possible to make some rather definite statements about the urban planning process in the United States and thereby identify the specific purpose of this particular information system.

THE PLANNING PROCESS

The planning process in the United States has as its goal the creation of an environment in which people can live and work usefully, productively, healthfully, and happily. This goal is to be achieved by progressively raising standards in four basic areas of human needs; shelter, facilities and services, supplies, and employment. Standards are raised by the creation of a design by which the city will develop in the future -- a design the specifications of which will guarantee raised standards and the structure of which will impose a dynamic, directional impact on the city's organic growth. The imposition of the design will be implemented by the standard democratic processes of public administration (Figure 1).

THE PLANNING PROCESS

GOAL

The goal of planning is to create an environment in which people can live and work usefully, productively, healthfully, and happily. This goal must be realistically set in terms of present and proposed

STANDARDS

Which are specific statements of the conditions of shelter, facilities and services, supplies, and employment which are acceptable to the society at large (National Standards) and to a given city (Local Standards). The translation of Local Standards into a program of urban development takes the form of a

DESIGN

Which is both a statement of specified standards to be achieved and a proposed structure of spatial organization by which to achieve these. The impact of the design is maintained by proper

IMPLEMENTATION

Which means the administrative processes by which the citizens of the city and all its component communities are brought together in a cooperative effort to institute and maintain the design.

Figure 1

Goal

The goal of planning -- the creation of a desired environment -- is determined by the standards of a given society. The extent to which improvements can and will be brought about in the four basic areas of human needs depends to an important extent upon a specified "human condition". And the human condition varies a good deal, most obviously from one culture to another, but also from one part of the country to another, as well as among the different parts of one city. The important point here is that the planning outlook must be, in terms of what exists, relatively Utopian. Planners must be pragmatic, but they cannot be cynical. Their objective must always be to improve the human condition.

To improve the human condition, planners must attempt to design communities or groups of communities which will provide the proper environment for the promotion of the physical and mental well-being of every citizen according to his abilities and interests. The terms "proper environment" and "full economic opportunity", when defined as the specific goals of a particular planning group, obviously do not mean the same thing to all communities or to every citizen. They must relate to people both as Americans and as members of a given community.

National goals

Americans have strongly held convictions that every American, whatever his social-economic-political situation, should be assured an environment which provides "proper" schooling, "appropriate" conditions of employment, and "decent" living and working conditions. Nationally, many of these standards have been defined by legislation and constitute a planning framework to which any planner must adhere. These standards are constantly reviewed by the national government and revised upward.

Local goals

Even in communities which enjoy exceptionally high standards of living, planning goals must represent improvement. Essentially they must relate to what the people of a particular

community need, want, and can pay for. Planning for both individual and "corporate" citizens must recognize the fact that it is they who provide political and economic support for the entire gamut of public activities involved in preparation and implementation of an urban plan. Thus there are national minimums below which no planning goals must go, but the maximum goals depend upon the desires and abilities, the ambitions and skills, of the citizens of any given community.

Goals expressed as individual and community needs

The planner can express his goals as the material requirements of the citizens of his city for shelter, facilities and services, supplies, and appropriate employment. These terms are defined here, as they are by planners, inclusively, to admit every possible planning responsibility.

Shelter. For both private (commercial as well as noncommercial) and public sectors of housing, the planner must provide for: (1) adequate amounts of housing for all segments of society; (2) appropriate sites for all types of housing; (3) suitable housing standards to insure health and safety, beauty and convenience.

Facilities and services. For all individuals, groups, and communities the planner must provide for a vast complex of both facilities and services, public and private, to meet individual needs and to provide the proper setting for group and community cooperation. These include such things as: (1) communications facilities and services associated with roads and sidewalks, mass transit systems, postal services, telephone and telegraph services, and such mass media as radio, television, newspapers and periodicals; (2) educational and religious facilities and services associated with schools, churches, libraries, community centers, and the like; (3) public health and welfare facilities and services associated with sewage disposal systems, systems of flood and water control, recreation centers, orphanages, homes and care for the aged or indigent, hospitals, cemeteries, public health and rescue services, and the like; and (4) protective and regulatory facilities and services associated with control of fire, nuisances

and hazards (water, soil, and air pollution; traffic), delinquency and crime, and the like.

Supplies. For all individuals, whether for their personal uses or for uses associated with provision of services and other types of supplies, the planner must provide for (1) utilities (water, electricity, and the like); (2) consumer goods, by which is meant appropriate arrangements for efficient, continuing, and growing provision of all goods the householder requires; and (3) producer goods, by which is meant appropriate arrangements for efficient, continuing, and growing provision of manufactures, semi-manufactures, and raw materials used by commerce and industry.

Appropriate employment. For all individuals, and for the community as a whole, the planner must provide for: (1) a range of employment opportunities suited to the range of capabilities of the labor force; (2) a balanced industrial structure which effectively and efficiently reflects the locational advantages of the community, as well as the market demands and labor potentials of the people, and (3) a range of employment-of-leisure-time opportunities suited to the range of needs of the community.

All of these needs -- and no human need, material or spiritual, can be ignored by the planner -- have been defined by such terms as "adequate", "appropriate", "proper", and "suitable". These terms obviously vary in meaning from place to place and among classes of society. If the planner is to recognize what must be done to meet these needs, he must be able to express them in a reasonably concrete fashion. In this way he can "set his goals" and measure his accomplishments. A concrete expression of such needs is here referred to as a "standard".

Standards

Existing standards are specific statements of the conditions of shelter, services and facilities, supplies, and appropriate employment which a society or a community will accept. National goals for meeting human needs and improving the human condition have to some extent been expressed by legislation which specifies minimum planning standards. Local goals must be based on a

realistic knowledge of what the existing standards of a given community actually are.

National standards

National standards are, in general, measures of minimum acceptable conditions, established by competent professional authority and accepted as authoritative by the general public and by local planning authorities. They tend to be expressed as "codes", often rather generally stated so that states and local communities may define them specifically in relation to their local society and economic conditions. These standards govern the activities of a wide range of people, from architect to mayor, from builder to highway commissioner to manufacturer. They include such things as housing codes, compulsory education laws, professional licensing requirements, wage and hour legislation, procedural codes for food processing, and the like. The term "national standards" is not nebulous, although it is too complex to discuss in its entirety here. Planners, city officials, and the many professional and technical people who build and operate and supply a city know what these standards are. Schools are not built to provide for 90% of all school-age children. Water supply and sanitation systems are not built to be "relatively" safe. Building codes are not based on minimum safety factors.

Local standards

Local standards are specific measures of the status of shelter, services and facilities, supplies, and appropriate employment as they exist in a given city or community. For example, it is possible to measure existing standards of shelter by some such "indicator" as: house value per member of family, number of rooms in a house per person, the condition of the property, or a combination of these. One can then determine the "average" condition in the city or community and the variations from average. In this way the planner knows what exists and what has been accepted. He then needs to know what constitute acceptable standards for planning.

Standards of shelter for planning must specify minimum acceptable conditions for the city as a whole, as well as minimum acceptable conditions for various portions of the city. Minimums for the city as a whole may be based in part on existing conditions which meet national and local codes. But in the final analysis the establishment of local standards must be based on political decisions -- at least so long as city planning in America continues to be the democratic process it is now. In other words, elected officials supplied with concrete statements of the existing status of things must decide how much improvement is desirable and possible.

Local standards are unique. While national goals and standards provide what we may refer to here as a "policy for goals and standards", it is a fact that every city has its own unique personality. Planning for a given city must be based on a tailored set of goals and realistic standards. The factors which distinguish cities in this sense have been generalized as follows:

(1) Needs and status of local population. The people of a given city have a certain, measurable ability either to demand or pay for certain quantities of shelter, facilities and services, supplies, and employment of varying qualities. These are the existing standards of that city; they vary from class to class of society and from one place to another. The "average condition" is the starting point for determining what standards are. The variation around the mean is an indication of the range of existing standards.

(2) Financial position of people and government. The extent to which the standards of one city are higher or lower than those of another city is probably basically related to greater wealth and differing social structures. Planning standards must be related to the ability of the city to pay for the improvements -- both citizens in their private expenditures and local governments in their public expenditures. Planners know that some cities cannot afford the high standards that other cities consider minimal.

(3) The physical qualities of the location. The physical peculiarities of a given location -- terrain configuration, water supply, soil, vegetative cover, climate, and the like -- will enforce certain practices and therefore certain standards. Particularly this will help establish local standards of road construction, building weights and heights, classes of land use, and the

like. These may vary from place to place within a city as well as from one city to another.

(4) The internal structure and functional relationships of a city. A city is made up of a number of places used for different purposes and spatially related. For example, residential areas are functionally related to areas of employment, both in movements of people (transportation standards) and in the qualities and requirements which do not permit both to occupy the same space or even to be adjacent (land use zoning standards).

(5) The relationships of a city to other areas. A city is inevitably a part of a larger spatial system, the region. For example, a city's basic economic activity -- the activity which produces goods sold to external markets -- is a function of the capacity of the city to produce those goods competitively and of the region to consume them. Conversely, the city is a market for goods produced "outside", as well as "inside". Standards for an appropriate balance of basic and nonbasic economic activities must reflect this relationship. It is important, too, to consider the relationship of city to region in establishing planning standards for relating facilities and services, such as transportation systems, communications systems, water distribution and sewage disposal systems, and the like. Here standards may depend upon the basic requirements for coordination of effort.

In summary, realistic appraisal of existing standards and establishment of planning standards (the concrete representation of planning goals) are absolutely basic to planning. Therefore these processes are absolutely basic to the development of a planning information system.

Design

To meet goals of higher standards, the planner must look into the future and decide what changes need to be brought about and specifically where these changes will take place. In other words, he must provide a design for tomorrow's city -- a design that will be both spatial and functional, showing how the city will look and how it will work. The design effort, which many people consider the very heart of the planning process, is both scientific

and artistic. It should be based on a detailed and rational knowledge of the city -- a model. But the form it takes depends upon the ingenuity and inventiveness of the planner in seeking a patterned solution to the many related problems he faces. It is probably the case that there is no one best design for a given city, and the usual design process is to develop a series of spatial arrangements in an attempt to find one generally acceptable to most of the people whose responsibility it is to approve or reject designs. The business of judging various designs is complex, because designs tend to differ in the following complex ways: (1) in their actual appearance, or spatial structure; (2) in the "mix" of standards they provide, which is partially a reflection of (3) the values each design stresses -- for example, mobility vs. cost, economy vs. aesthetics, and (4) the varying cost of putting differently designed plans into effect and maintaining them.

The design process

Design is action -- a process involving three related steps of great significance to information requirements.

(1) The model. Basic to any design considerations for plan development is a "model" of the community in question. The model is a realistic statement of present and projected local standards. The planner must know how many people of what age and economic levels to expect in the future; he must relate this information to present and anticipated standards of shelter, facilities and services, supplies, and appropriate employment; and he must then establish the framework of relationships within which his design must operate. This "framework of relationships" may take the form of a series of statements of community need. It may take the form of a series of maps. It may take the form of a series of mathematical statements of relationships. These are the three forms models assume, and their significance in the information system will become more apparent as the details of the system are discussed. In brief, models take into account what the city is and what the people will be. With a model the planner knows what he has to work with and has a basis for predicting the requirements for the future. He can then build upon the present city by developing a design that will keep the best of what exists and improve upon the rest.

(2) Construction and application. Given a model (which states the city's standards in related terms), the planner may use different designs which express these relationships in different forms. Fundamentally design is spatial arrangement. For example, names of a number of design constructs are "the dispersed sheet", "the core city", "the galaxy of settlements", "the urban star", "the ring", "the polycentered net". Therefore, a design for a planned city is a spatial arrangement, a form which must relate the functional parts of the city in an effective fashion. The tremendous significance of this statement must be understood. A design, once initiated, does in fact relate the functional parts of a city effectively; whether it does this desirably or not is another matter. For example, a design which emphasizes accessibility of the city core relegates every other section of the city to a minor role, relatively speaking, in the hierarchy of accessibility. Designs for the total city inevitably effect every segment of the urban place, from planning area to neighborhood, from subdivision to lot. Detailed plans for parts of a city must coincide in structure and intent with the overall design. If they do not, they simply will not "work". It is therefore of the utmost importance to understand how the parts of a city are related and how a specific design may affect and perhaps change these relationships.

(3) Design evaluation. In simplest terms, once the planner has evolved a design he should be able to "test" it against his model. Too often the unanticipated "side effects" of a hasty design have depressed as many parts of the city as they have improved. Or a design proves to be hopelessly expensive. Because a city is so terribly complex and incompletely understood at best, it is essential that the planner use all of his experience and all forms of models to bear upon the design evaluation phase of planning. Good planners evaluate almost intuitively: that is to say, on the basis of experience. But more is needed. The planner needs more effective ways of using the models he has -- maps and photographs, primarily. And he needs more sophisticated models -- mathematical models which will permit testing of complex relationships involved in design change by means of high speed computers. The planner must be able to predict the effects of the design he recommends before it is implemented.

Implementation

Any design is only as good as the extent to which it is put into effect. The planner cannot afford to develop his plans without due consideration of the political processes of his community. He must start with a careful and balanced design that will achieve the goals recognized as desirable within his community. But he must not think his job is complete once he is satisfied, professionally, that his design is sound. He must also explain and defend his plan to chief executives, legislative officials, heads of independent agencies, community groups, and interested citizens who individually and collectively are able to exert considerable influence on the implementation of plans. For their part, these groups should learn to appreciate the professional judgment of the planning agency staff.

The political leaders, not the planner, possess the final decision-making authority within the government. It is they who must reconcile the differences among competing groups and who are responsible for their actions directly to the people through normal democratic processes. The burden of cooperation between planner and political leader must fall principally on the planner. The information system described should enable the planner to make rational decisions concerning the future growth and development of his community. But the planner works closely with his data and employs his professional judgment based on long experience with planning problems. Such a background is frequently denied the lay political leader. The political leader addresses himself to a host of problems other than planning and commonly finds the atmosphere in which he operates more frenzied and harried than that surrounding the work of the planning agency. Recognizing this, the planner must show to the political leader, in terms that hold his interest, just what a design will do for the city and its people.

The ideal situation would be one in which planners and political leaders work together in establishing community planning goals. A joint effort to formulate explicit goals would have two desirable results:

(1) The issues of planning would be better integrated into the political process and would therefore be elevated from the

realm of local interest to the more critical realm of city interest. Most planning issues have an impact beyond the immediate community and should be of concern to the entire city.

(2) Political leaders who control the implementation of plans will have taken part in the goal-formulation process and will therefore have subscribed to the plan. If they do not support its implementation, they run the risk of being inconsistent.

In short, cooperation between planner and political leader is essential if planning is to be successful in a democratic society. An information system should provide the data upon which sound planning is based and by which it is judged. But to make a plan a reality requires an understanding of the role that both the professional planner and the political leader play in the planning process.

INFORMATION NEEDS RELATED TO THE PLANNING PROCESS

The foregoing description of the planning process has pointed up the portions of the process which depend upon information. Specifically, the planner needs information if he is to:

(1) Establish planning goals -- because goals depend first of all upon a knowledge of what standards actually exist in a city; only with this information can political decisions be made concerning what the standards ought to be.

(2) Construct realistic models, the basis for the creation and evaluation of designs -- because the design of a plan depends upon an intimate functional and spatial knowledge of the urban place.

(3) Implement the plan -- because administration of a plan by such means as subdivision regulations and zoning ordinances requires a detailed factual knowledge of all segments of the city.

In all cases it appears that the planner's needs for information are focused on his city as a relatively unique spatial entity (Figure 2). The factors which make his city unique with respect to standards of shelter, facilities and services, supplies, and

A planner's information needs are focused on

INFORMATION NEEDS OF THE PLANNING PROCESS

GOAL

Shelter   Facilities & Services   Supplies   Employment

STANDARDS

NATIONAL

General measures of minimum acceptable conditions of the four classes of human needs -- established by competent professional authority and accepted as authoritative by the general public and by local planning authorities.

Basic to any "policy" for goals and standards.

LOCAL

Specific measures of the status of the four classes of human needs as they exist in a given city or community.

Basic to any specific set of goals and standards for a particular city, because cities differ in the following respects:

- Needs and status of local population
- Financial position of people and government
- Physical qualities of the location
- Internal structure and functional relationships
- Relationships of a city to other areas

DESIGN

Model   Construction and application   Evaluation

IMPLEMENTATION

Adoption   Enactment   Enforcement   Modification

Figure 2

employment are specifically the factors about which he needs information. They are:

(1) The needs and status of the local population.

(2) The financial position of the people and the government.

(3) The physical qualities of the location.

(4) The internal structure and functional relationships of the city.

(5) The relationships of the city to other areas.

It is around information about these things that a planning information system must be built.

CHAPTER 3. AN INFORMATION SYSTEM FOR URBAN PLANNING

If the information process and the planning process have been properly described in the preceding chapters, one can now specify the steps by which an information system for planning may be evolved. They are these:

(1) Specifying the data needs. The five areas of critical information (Figure 2) must be redefined in terms of specific information requirements.

(2) Relating data in terms of an integrated system. The specific data identified in step (1) must be associated with specific methods of information processing.

(3) Evaluating the system for practicability. One must determine whether the information is actually available and whether the cost of collection and processing is reasonable or not.

(4) Evaluating the system for effectiveness. A practicable system must still do what it is supposed to do.

The four steps by which one develops an information system for planning appear neatly linear and sequential as they are stated, but they are really anything but neat. The processes are interrelated by a series of feedbacks -- a trial and error method

of adjustment and readjustment. The reason for this is that the city is both terribly complex and extremely dynamic. There is no precise model which identifies the complex relationships that define an urban place. An information system can be instrumental in the development of a model, as the discussion in the preceding chapter attempts to show, and a developing model will unquestionably be instrumental in developing a more effective information system.

Although there is as yet no model as such, there is experience, both in planning and in information handling. The first step, specifying data needs, is based on planning experience, the very fundamental but implicit understandings of urban places that become the basic stock in trade of planners. The second step, the treatment of each piece of information in an integrated system, is based on information experience; in other words, it is organized and systematized.

SPECIFYING DATA NEEDS

The first step, then, is to redefine the five areas of critical information (Figure 2) in terms of specific information requirements. This has been done in the following way:

(1) Needs and status of local population. This amounts to demographic information, but of a type pertinent to the planning process: age groups; jobs; vacations; travel budgets of various sorts, as an index of internal mobility, and the like. Because planners plan for people and indicate that this information is absolutely essential, and because population and population traits are so dynamic (in American cities), it is felt that this information ought to be collected annually by the planner. Only thus can he determine what standards exist and what is happening to those standards, an essential information adjunct if planning is to work at all. The specific "family characteristics" data to be collected are:

Number of members of specified age groups in family
For head of household:
- Sex
- Vocation

Time of travel to job in minutes
Method of travel
Length of vacation in days

For second employed member of household:
Sex
Vocation
Time of travel to job in minutes
Method of travel
Length of vacation in days

Number of members of family employed
Time of travel to grocery store in minutes
Method of travel
Time of travel to school in minutes
Method of travel
Number of months family resident in metropolitan area
Number of months family resident in present dwelling
Family income level
Number of cars owned by family
Land use
Condition of Property
Location

However, this does not tell everything that needs to be known. It tells what people do for a living, but one must be able to match these "employee characteristics" with "employment characteristics". Therefore, an additional source of essential information is the employer, from whom the following information is to be obtained:

Employer (Kind of business)
Number of employees
Per cent employees male
Occupational title of largest employed group
Occupational title of second largest employed group
Occupational title of kind of employee most difficult to find
Median employment period in months
Median monthly salary
Median hourly wage
Employment peak: season (spring, fall, winter, summer) or none

Employment low: season, as above, or none
Per cent "input materials" from within metropolitan area
Per cent market within metropolitan area
Name code (firm)
Number of locations within metropolitan area
Months in business (life of firm)
Months in metropolitan region
Months at same location
Location

(2) The financial position of people and government. The ability of the individual to pay for non-governmental costs of improving standards can be based on income characteristics of the population, a measure of which is already included in the data of paragraph (1), and property values, a measure of which will be made in conjunction with another information area. [Paragraph 4]. A determination of present and potential revenue yield for the government will be based on essentially the same figures. Therefore, there will be no separate data collection for this area.

(3) Physical qualities of the location. Information about slope, drainage, soil and subsoil conditions are most useful to the planner if they are portrayed spatially -- on maps or photographs. These data should be on hand in the fashion most useful for the planning purpose, but their collection is felt to be largely the primary responsibility of other government agencies. For example, topographic mapping appears to be the responsibility of the Sanitary Commission. However, it is impossible to generalize about responsibilities for data collection, because local governments differ so markedly from place to place. The rule to follow here is not to duplicate an effort already made. Planners should learn to borrow freely, because their information needs are so vast.

(4) Internal structure and functional relationships of the city. This is the most complex category of information required. In the vernacular, it is an attempt to answer the question, "Where are things and what's going on?". The answer historically given by planners is an identification of the uses to which the land is put. The single plot of land devoted to a particular use is referred to as a parcel. Basic information about a city's structure involves knowing the use of each parcel of land, its size and value, and

its location. This information is used quantitatively -- for example, to add up total area or value of land devoted to a particular use; it is used spatially, as well -- for example, to see how various kinds of land use are distributed relative to each other and to determine what "structure" this gives the city. Therefore, land use information must be total information and must be collected and stored in two forms, numerical and pictorial. Because the expense of collecting such information has for most planning agencies been prohibitive, many planners have gotten along without it. That is, they have made surveys of specific areas for which they were developing plans, or they have made periodic surveys; once every decade would be quite often for most planning offices. Sometimes they have simply had aerial photographs made of their areas and managed with that information.

Since this is easily the most significant and critical area of information a planner must have -- without which he cannot know what standards exist, what goals to set, and what kinds of designs to attempt -- it seems imperative to include it in the information system. Two concepts have made this possible without adding unreasonable costs to the planning process. One is that in any city the Assessor's Office is responsible for evaluating all properties for purposes of taxation. Assessor's Offices are as overworked as are other offices, but still they must make periodical evaluations. And more and more Assessor's Offices are keeping their records in machine form, as is the case in Montgomery County. It is also the case that the Assessor is willing to add a few items to his assessment survey, items of considerable use to a planner. These are:

Land use (primary)
Number of dwelling units on property
Condition of property
Zoning classification
Single or multiple land uses on property

Added to the information the Assessor had to begin with (size, land evaluation, improvements evaluation, and total evaluation), these additions provide a source of extremely valuable information for planning. To transfer this information from Assessor to Planner is a mechanical matter of creating a duplicate deck of punched cards. And to make this duplicate deck the foundation of

his information system, the planner has only to add location, based on a coordinate system which will identify any parcel down to a size of 50' X 50'. (Map 1).

(5) Relationship of the city to other areas. One of the most fundamental relationships a city has with other cities is economic. How much of its market lies outside its "city area"? How much of its supplies must be imported from outside its "city area"? The normal method of assessing the relative proportions of basic (exporting) and non-basic (for local consumption) economic activities is detailed and expensive. An attempt has been made to get general information of this sort in the employment characteristics survey.

The other relationships fundamental to planning do not demand information so much as they do coordination. Plans of adjacent areas for "linking facilities and services", such as transportation and communications networks, and for "overlapping facilities and services", such as utilities, need to be fully coordinated. Coordination can be made not only possible, but quite simple as well, by means of the visual information processing.

RELATING DATA IN TERMS OF AN INTEGRATED SYSTEM

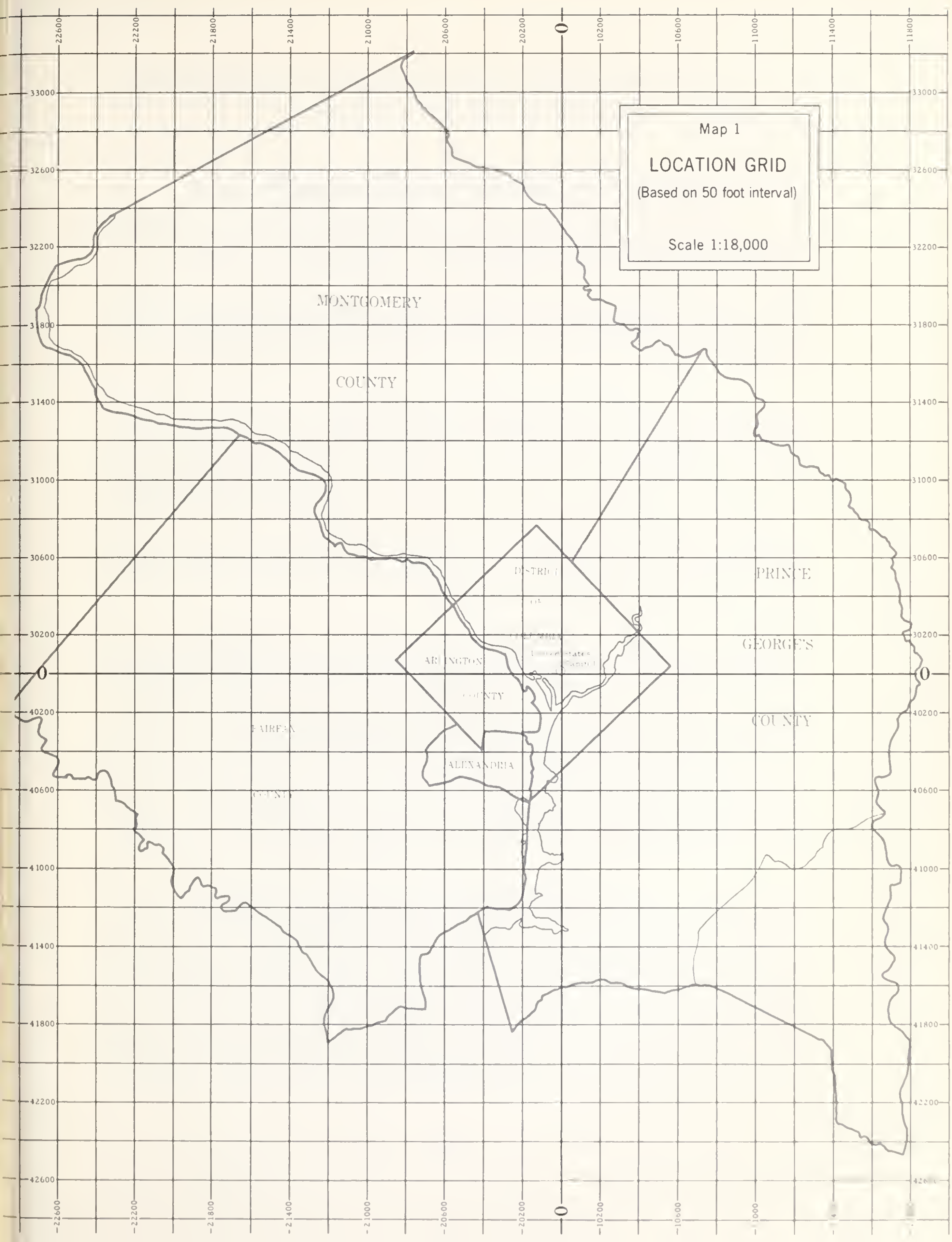
A number of generalizations can be made about the data specified in the preceding section, perhaps the first of which ought to be that it obviously cannot be organized on the basis of the five critical areas of information needs.

General characteristics of data needs

(1) The fundamental and essential information for planning is a knowledge of how the land is being used.

(2) Planners plan for "people". They must know the qualities and characteristics of the people who inhabit their particular urban place.

(3) Planners use such detailed information that they absolutely require machine methods of data proecessing.


Map 1
LOCATION GRID
(Based on 50 foot interval)
Scale 1:18,000
MONTGOMERY
COUNTY
PRINCE
GEORGE'S
COUNTY
DISTRICT
ARLINGTON
COUNTY
ALEXANDRIA
22600
22200
21800
21400
21000
20600
20200
0
10200
10600
11000
11400
11800
33000
32600
32200
31800
31400
31000
30600
30200
40200
40600
41000
41400
41800
42200
42600

(4) Planners rely heavily on visual models of spatial information -- primarily photographs and maps.

<u>General specifications for the information system</u>

With these generalizations in mind the structure of the information system can be specified. Essentially it is this:

(1) <u>Land use information will constitute the only class of total information for the system and will be the sampling "universe"</u>.

(a) Land use information is treated quantitatively (per cent of area in various forms of land use, etc.) and spatially (area- , distance- , and direction-relationships of differing land uses), and is therefore collected in terms of both number language and picture language. In other words, there should be total coverage of land use information both numerically (in the form of punched cards and magnetic tape) and pictorially (in the form of photographs and maps which have been reduced to 35 mm. film size and stored on aperture cards).

(b) In most urban places, as in Montgomery and Prince George's counties, the agency which must of necessity visit every "property" with some regularity is the Assessor's Office. In cities the overwhelming trend is to keep assessment information in an automated system. It is therefore suggested that an arrangement be worked out with the Assessor's Office to put a few additional items on the assessor's list of information collected on each visit to a property. Information kept in an automatic system can be duplicated for other uses with virtually no effort or expense.

(c) Assessments are based on the property, land held by a specified owner who pays the taxes, as a unit of collection. Properties in urban areas may be broken up into a number of units with different uses (parcels). Where this is the case, the planning agency will have to identify such parcels and make a separate record (punched card) for each parcel. These cards will fill out the universe of land use information and will of course be "keyed" to the original property card. That is, the duplicated property cards plus the additional parcel cards will represent

approximately all instances of land use in the area. This is the basic information universe upon which sampling for other kinds of information will be based.

(d) The aerial photograph adds a most realistic dimension to spatial phenomenon. It is therefore proposed that land use information be superimposed on aerial photographs, either identified by photointerpreters and therefore independent of the punched card data, or machine-mapped by punched card data and then transferred to aerial photographs, whichever proves to be the more economical method. The resultant photo-maps should be photographed and reduced to 35 mm. film, to be stored on aperture cards for rapid retrieval and effective analysis.

(e) Using the above land use maps as a base, put the current zoning on "overlays", which, when reduced for use on aperture cards, can be photographically superimposed on the land use photographs.

(f) All punched cards and aperture cards (the latter also have space for considerable numerical information in punched form) should be related by a location code.

(2) The universe of land use information on punched cards and tape will be used as the sampling base for collecting "family characteristics" and "employment characteristics" data.

(a) Family characteristics data collection will be based on a representative sample of all residential land use cards.

(b) Employment characteristics data collection will be based on a representative sample of those cards implying primarily employment land use, rather than residential.

(3) Physical information which is essential to proper planning is terrain information (topographic maps) and ground water information. Generally speaking the responsibility for knowing about these characteristics of place varies widely from one city to another, and the pattern of collecting this information varies also. But it is recommended that coordination be sought here, and that the planning agency exchange information with such other "users" as the Sanitary Commission.

It should be noted here that other forms of information not collected by, but produced by, the planning process will become integral parts of the information system. Planning region maps, master plan maps, and proposed zoning maps will all be put into the system on aperture cards.

Any maps and aerial photographs which are felt to be useful can so easily be stored and used by the aperture card method that they can be included in most systems without impairing the effectiveness of the system.

EVALUATING THE SYSTEM FOR PRACTICABILITY

The most important consideration in the entire proposed system is the cooperation of the Assessor's Office. But this should cause no real difficulty. In the first place, the additional information to be collected by the individual assessor when he visits a property is no real burden; it might prove to be very useful information to the Assessor, in fact. In the second place, most cities which require planning offices are large enough to need data processing equipment, and if the assessment procedure is not automated it surely will be in the near future.

It is not possible to assess the entire magnitude of the additional data collection burden created by multiple land use properties without first having the complete set of properties information from the Assessor's Office. However, people familiar with urban land use suggest that properties with multiple uses will be on the order of 10% to 15% in an area that is both urban and rural like that under the jurisdiction of the Maryland-National Capital Park and Planning Commission.

The sampling procedure is considered eminently practicable. There are no questions which the interviewee cannot answer in either case. In a test of the family characteristics data collection procedure the only problem encountered was that in some families both adult members are employed and there is no one at home during the day, a problem which can be corrected by making evening calls in apartment areas. The employment characteristics data collection procedure will not have this problem.

Aerial photography is essential and is inexpensive. Air photo coverage at a scale of 1" = 1500' is adequate for 1" = 200' scale photo maps. For an area of 1,000 square miles (slightly larger than the jurisdiction of the Maryland-National Capital Park and Planning Commission), the estimated cost of photography for all uses except horizontal control, providing 1" = 200' prints, is less than $10,000. Adding land use by photo-interpretation at a scale of 1" = 1/2 mile would cost an estimated additional $7,500.

The automation of a data system is eminently practicable. Jurisdictions of planning agency size have already moved toward standard punched card processing equipment, and the cost of installing aperture card systems is slight compared with the tremendous advantages they offer in increased effectiveness of the use of visual materials. In fact, the cost of such systems is slight compared with the cost of computer systems of any sort.

EVALUATING THE SYSTEM FOR EFFECTIVENESS

No system can be evaluated for effectiveness until it has been put to the test of actual usage. This system is dynamic. A key feature is <u>annual</u> information. Until a planning agency has had a chance to work with such data and begin to maintain a record of trends in development and growth, there is no way of knowing how effective it really is. Also, until planners have had a chance to use the powerful adjuncts of a visual information system they cannot know what they have been missing before! However, there is no question that the system will be modified in details as it is used.

CHAPTER 4. DESCRIPTION OF THE NUMERICAL INFORMATION SYSTEM

Numerical information in the urban planning information system consists of three decks of punched data cards:

(1) The "Land Use Deck", which is the "universe" of numerical information and which is made up of two subdecks: the "Properties Subdeck", and the "Supplemental Parcels Subdeck".

(2) The "Family Characteristics Deck", which is a sample based on the Land Use Deck.

(3) The "Employment Characteristics Deck", which is also a sample of the Land Use Deck.

In this chapter each of these decks will be described separately, in terms of (a) data collection methods and procedures, and (b) storage and retrieval methods and procedures. Analysis and use of the total system will be discussed at the end of the chapter, as will the machine installation requirements of the system.

THE LAND USE DECK

The land use deck constitutes something approaching total information on the use, size, location, and value of every parcel

256-721 O - 67 - 6

of land in the planning jurisdiction. (Total information does not exist.) This basic "universe" of information comes from two different sources which are integrated as one deck. The Properties Subdeck is a machine modification of information collected by the Assessor's Office. The Supplemental Parcels Subdeck is information on sub-units of individual properties and is collected by the planning agency.

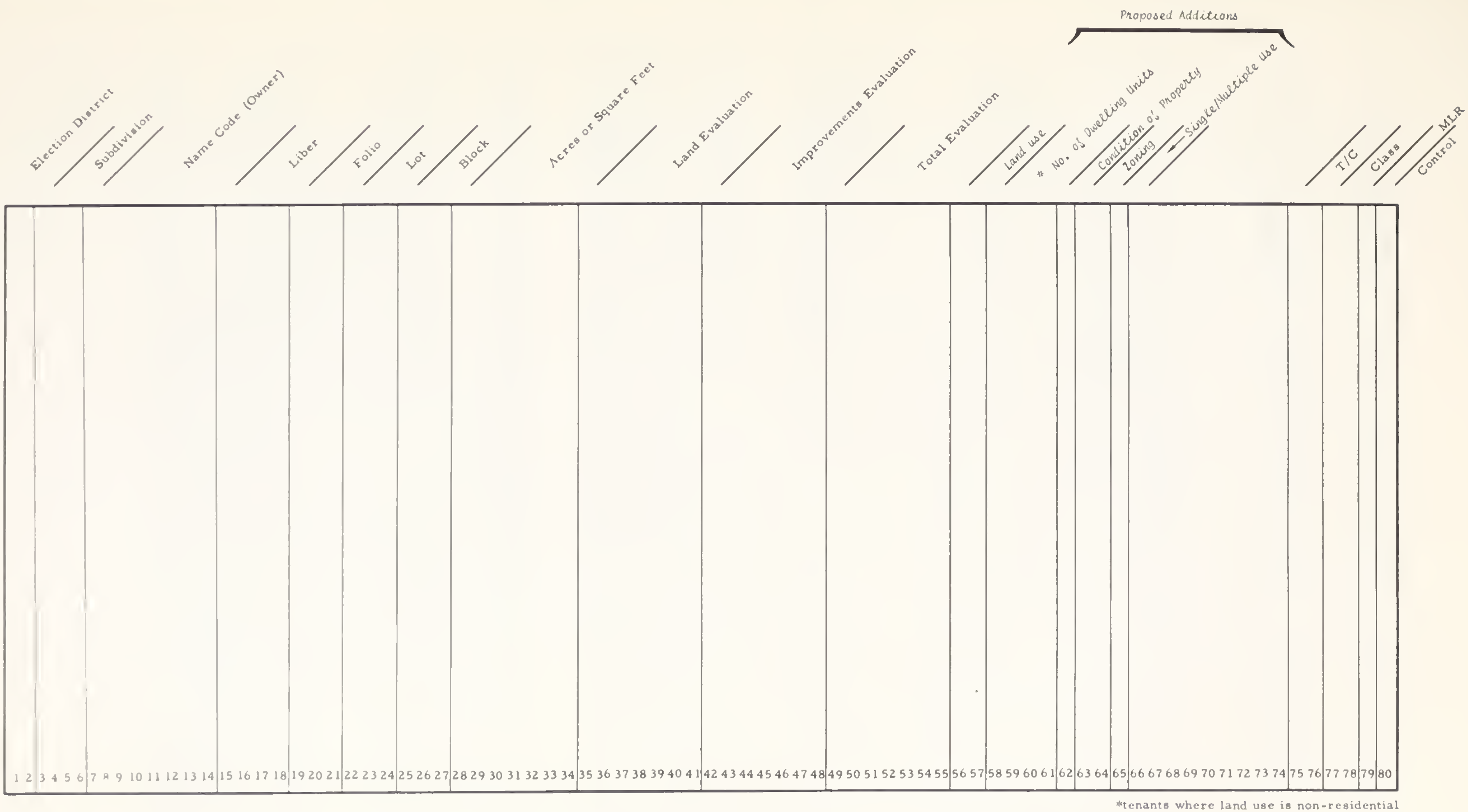
The Properties Subdeck

The present data card kept by the Assessor's Office contains information on ownership and values of individual properties. (At present, in the counties under the jurisdiction of the Maryland-National Capital Park and Planning Commission, the Assessor's Office visits all properties about once every five years.) It has been proposed that the assessor add five new items of information to those he now collects on each visit to a property (Figure 3). When these are added, the information from the Assessor's data card can be automatically transferred to produce a basic information card for the planning agency. On this the planning agency will add the "key" element of all data cards -- location.

Collection

The collection procedure will involve, first of all, the addition of several new items by the Assessor to his present data card, and secondly, the modification of the information on that card for the planning agency's Properties Subdeck.

New Items on the Assessor's Card. Collection of information for storage and retrieval in an automated numerical system, involves a system of noting information on some storage device, such as a punched card or magnetic tape, in the form of numbers. The punched card contains 80 columns, each numbered 0 through 9, and a hole punched through one of these numbers represents that number. The numbers may represent specific quantities; for example, under Land Evaluation or Square Feet, the number is a direct measure of dollars or square feet. Or the numbers may stand for some other information; in this case they are referred to as a code.



ASSESSOR'S DATA CARD
with Proposed Additions

Figure 3

Of the five new items proposed for the Assessor's Data Card, one represents quantities and the others are codes:

Columns 58-61: Number of Dwelling Units. This is simply a measure of the number of such units on a single property and will be recorded as such.

Column 65: Single or Multiple Use. This is simply a coded statement that the property is either used for a single use or more than a single use. Multiple uses will be characteristic of different parcels of a singly-owned property, whether those parcels are distributed horizontally (as in a subdivision) or vertically (as in an office building). If multiple use is indicated, this card will automatically be retrieved after it has been converted to the Properties Subdeck, and the necessary additional cards will be made for the Supplemental Parcels Subdeck.

The three remaining items will be coded according to the classifications suggested in a Maryland-National Capital Park and Planning Commission Information Bulletin, A Guide to Procedures for IBM Data Processing Project, October 1960.

Columns 56 and 57: Land Use. There may be more than one land use activity on a single assessment property. If that is the case, the primary use is to be indicated. Primary use is that which either occurs most often among a number of activities or occupies the largest area. The two digit code for classifying land use follows:

Residential: This category includes all activities which are customarily carried on within dwelling units.

However, it does not include transient lodging which is considered of a commercial nature, nor does it include temporary living quarters connected with educational and institutional facilities.

00 - Detached House: This is the normally conceived single-family residence; a free-standing building situated on its own lot.
01 - Semi-Detached House: Two single-family houses built side-by-side and sharing a common party wall.
02 - Row House: A series (more than two) of single-family houses built side-by-side on separate lots but sharing common walls.

03 - Garden Apartment: A group of dwelling units housed in a low (2 or 3 story), well landscaped building with a tendency toward individual outside entrances or at least having only 2, 3 or 4 units opening into a single entrance; designed for family living.

04 - Standard Apartment: Single entrance serving all or a large number of dwelling units; building covers such a large proportion of the site that there is very little if any usable yard space; usually not more than 4 or 5 stories in height; usually having no elevators, swimming pools or other "luxury" features; no outstanding attention given to landscaping; no particular attention given to family living; includes 2 or 3 unit flats which were built for the purpose; includes also standard apartment hotels.

05 - Luxury Apartment: Generally a high structure (more than 4 stories) with many dwelling units; not particularly well suited to family living; featuring elevators, swimming pools, garage parking, good landscaping and siting, central air conditioning, other luxury features; including luxury apartment hotels.

06 - Converted House: A relatively old single-family house (detached, semi-detached, or row) which has been divided into two or more apartment units.

07 - Rooming Houses: Houses having at least three (3) rooms available for renting.
Generally speaking, rooming houses will be fairly old, large houses originally built for single-family use.

08 - Trailer: Single trailers, trailer courts and trailer parks. Under type of structure indicate trailers as temporary.

09 - Other: Any residential use not elsewhere classified.

Commercial: This category includes all business services generally used by the public at large. Although non-client oriented offices do not fit this definition very well, they have been included because of their similarity to client-oriented offices which do fit the definition.

10 - Transient Lodging: Hotels (except apartment hotels), motels, tourist homes.

11 - Retail & Consumer Service: This category includes activities that provide consumer retail trade and services such as department, hardware, food, notions, jewelry, drug, book and variety stores, butcher shops, cleaning and pressing operations (except dry cleaning or laundry plants not having direct

service to customers), beauty and barber shops, and similar commercial uses.

12 - Client oriented Office: Offices which attract clients to a high degree, such as offices of doctors, (including out-patient clinics), lawyers, real estate agents, bankers and money lenders, architects, engineers, etc.

13 - Non-client oriented Office: Offices which do not attract clients to any great extent, such as large administrative offices of government agencies or private business enterprises (government office building, regional or national headquarters of an insurance company, offices of professional societies such as AIP, AMA, etc.)

14 - Heavy Service: Gas stations and all automobile services including new and used car dealers, lumber yards, welding shops, coal yards, building materials yards, dealers in farm and other machinery, building contractors, plumbing and electrical contractors.

19 - Other: Any commercial activity (non-industrial and non-recreational) which cannot be classified in 10 - 14.

Industrial: This category includes primarily business and government services which support other services such as the commercial category above.

20 - Manufacturing and Processing: Laundry and dry cleaning plants doing the cleaning rather than dealing with customers, readying agricultural products for market, converting raw materials or partly fabricated materials into products on a "production" basis, etc.

21 - Research and Testing: "Science industry" developing new principles and products, including prototype fabrication and testing. This type of industry commonly has laboratories, drafting rooms, and engineering offices.

22 - Warehousing: Indoor and outdoor storage of materials or products, serving as supply depots for retail outlets, government agencies and other large consumers.

23 - Junk Yard: Salvaging of used and discarded materials.

24 - Mining and Extracting: Sand and gravel pits, quarries, etc.

25 - Utilities: Production and distributing facilities for gas, electric, water, sewer, etc.

29 - Other: Industrial activities not classifiable under 20 - 25.

Transportation: This category includes all activities (except utilities) which are undertaken for the purpose of moving goods and people.

30 - Terminals: Bus, train, boat, plane, subway, taxi.
31 - Automobile Parking: Off-street lots and garages, public or private.
32 - Rail and Other Specialized Right-of-way:
33 - Streets, Highways, and Alleys:
39 - Other: Any transportation facilities not classifiable in 30 - 33.

Institutional: This category includes activities serving medical, spiritual, social, and charitable needs of the general public.

40 - Medical and Welfare: Hospitals, nursing homes, settlement houses, orphanages, old age homes, sanitariums, asylums, etc.
41 - Social: Elks club, masonic temples, and other clubs not established primarily for recreational or religious purposes.
42 - Worship: Churches, temples, synagogues, mosques, (including facilities primarily for religious instruction and counseling, but not facilities for secular education).
43 - Funeral Homes:
44 - Cemeteries:
49 - Other: Institution activities not elsewhere classified.

Educational: This category includes the major activities serving the educational needs of the general public.

50 - Nursery School: Day care for "pre-school" children.
51 - Elementary School: Normally includes kindergarten through 6th grade, but includes also grades 7 and 8 for parochial schools which are organized on an 8-4 system rather than on the 6-3-3 junior high school system.
52 - Junior High School: Grades 7 through 9.
53 - Senior High School: Normally includes only grades 10 through 12, but may include 9th grade also for parochial schools using and 8-4 system.
54 - Trade Schools: Schools giving business, accounting, technician, and other training above the high school level, but not leading to a college degree.

Public Service: This category includes non-business activities which serve the physical and cultural needs of the general public.

60 - Library: Book lending activities serving the general public.
61 - Community Centers, etc.: Including museums, art galleries, zoos, auditoriums, and exposition halls.
62 - Postal: Post offices, sorting stations, etc.
63 - Court, Public Record, and Related Activities: Court house, governmental information and licensing office, etc.
64 - Police: Park, state, county, and city police stations.
65 - Fire, Rescue, and Civil Defense: Stations, headquarters, and training areas.
66 - Military: Installations for anti-aircraft, training, flying and other military activities including national guard, but not including administrative offices such as are found at the Pentagon.
69 - Other: All other public service activites not classified elsewhere.

Recreational: This category includes the major activities which serve the recreational needs of the general public.

70 - Active Park: Playgrounds, playfields, tennis courts, and other game areas.
71 - Passive Park: Picnic areas, hiking trails, bird watching, camping, fishing, etc.
72 - Undeveloped Park: Land bought for park purposes but not developed at all.
73 - Reserves: Forest and wildlife preserves and conservation reserves.
74 - Camp, Beach, etc.: Boy Scout, Girl Scout, Church, and other organized camps.
Beaches open to the general public, whether free or for a fee.
75 - Golf Courses, Country Clubs, etc.: Golf driving ranges, swimming pool clubs, riding academies, etc.
76 - Commercial: Stadiums, race tracks, fair grounds, amusement parks, outdoor theater, miniature golf, movies, bowling, pool, gymnasiums, etc.
79 - Other: Any other recreational activity not classifiable elsewhere.

Agriculture: This category includes production activities based on the soil and weather resources of the land.

80 - All kinds: Food, fiber, landscaping, stock, etc.

No Activity: This category includes all land and water area not used for the activities classified above.

90 - Forested: All unused land with heavy stands of trees.
91 - Water Area: Large bodies of water such as a river, lake, or bay which have no specific use that can be attached to them to the exclusion of other equally important uses.
Smaller water areas, such as farm ponds, are to be included in the land area of the agricultural or other appropriate activity unless they are one acre or more in area.
99 - Other: Unused or vacant land having no heavy forest cover. This includes also land having on it abandoned and usually dilapidated or overgrown buildings, mines, quarries, etc.

Column 62: Condition of Property. This code refers to the condition of structures on the property, for which definitions follow:

1. Sound, good original construction with defects no greater than those which are normally corrected by ordinary maintenance procedures.

2. Deteriorating, good original construction having serious, but repairable defects which do not extend over large areas.

3. Dilapidated, unsound original construction or good original construction having defects in maintenance either so critical or so widespread that the structure should be extensively repaired, rebuilt, or torn down (See F-200, Enumerator's Reference Manual, Stage 1, 1960 Census).

4. No structures.

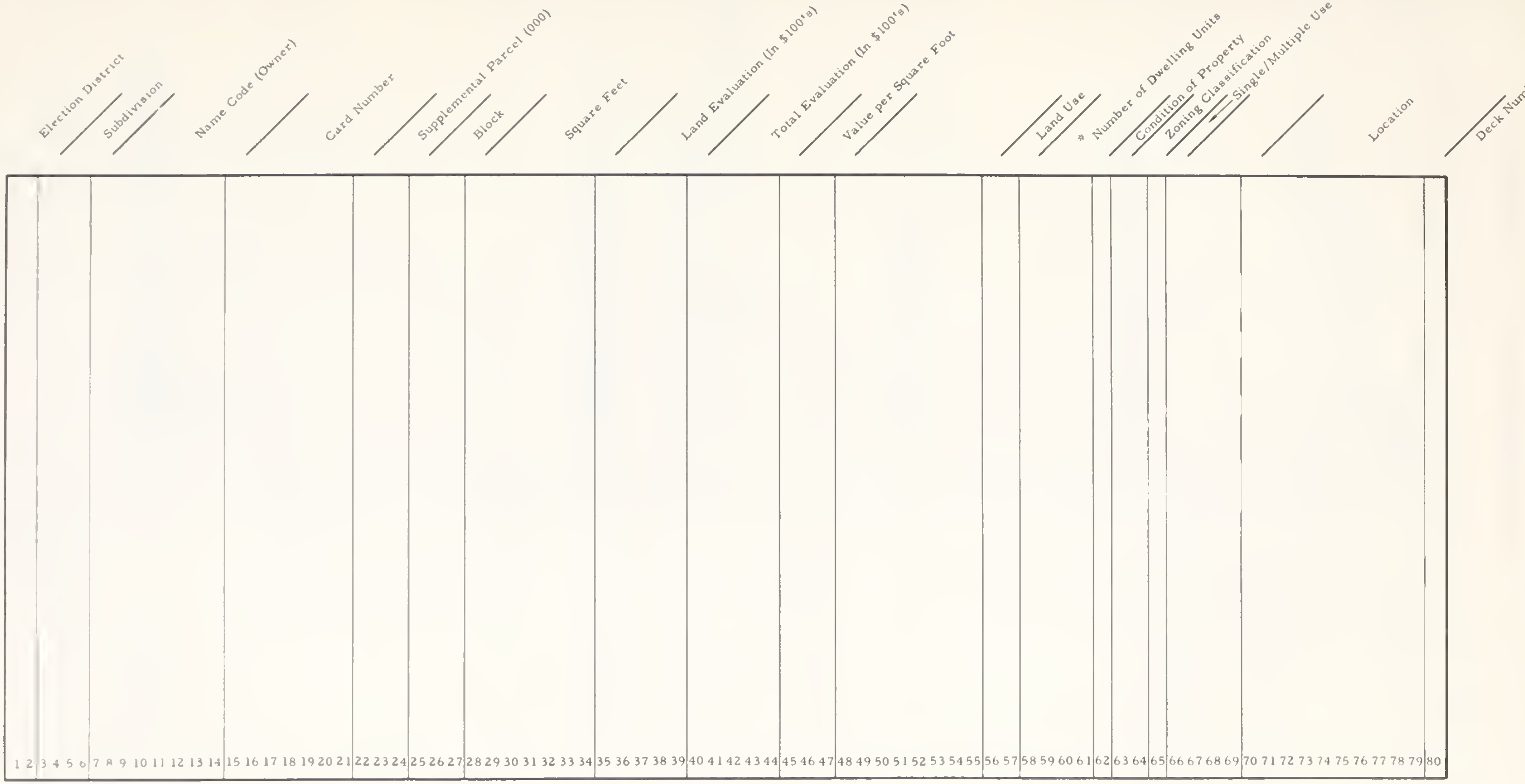
Columns 63 and 64: Zoning. The two digit code for zoning designations in both Montgomery and Prince George's counties is as follows:

256-721 O - 67 - 7

Code	Montgomery County Zone	Prince George's County Zone
10	R-A	
11	R-E	
12	R-R	R-R
13	R-90	R-P-C
14	R-60	R-55
15	R-40	R-35
16	R-30	R-20
17	R-20	R-18
18	R-10	R-10
20	C-0	C-0
21	C-1	C-1
22	C-2	C-2
30	I-1	I-1
31	I-2	I-2
32	I-3	

<u>Producing the Properties Subdeck.</u> The collection procedure for the planning agency involves changing the Assessor's card to meet the purposes of planning. New items of information will be added, old items will be deleted, and the form and location of some items will be changed (Figure 4). This entire procedure will be done automatically, except for the addition of a ten-digit location code. The transformations described below can be accomplished on a computer. A variety of computers have this capability -- for example, the IBM 607, 1620, or 1401.

The entire process is graphically illustrated by a comparison of Figures 5 and 6. The classes of information identified as Liber, Folio, and Lot have been omitted from the Property card and have been replaced by a card number, a numbering sequence to identify each card in the deck, and the supplemental parcel number. Columns 28 through 34 have been changed from "Acres or Square Feet" to square feet only. Land Evaluation has been changed to figures in hundreds of dollars, and the space taken by this has been reduced from seven columns to five columns. Improvements Evaluation, columns 42 through 48, has been deleted, and Total Evaluation has been stated in hundreds of dollars and moved to columns 40 through 44. Columns 45 through 47 now



*tenants where land use is non-residential

PROPERTIES DATA CARD

Figure 4

ASSESSOR'S DATA LIST, WITH PROPOSED ADDITIONS

Column		Column	
1		41	Land evaluation
2	Election district	42	
3		43	
4		44	
5		45	
6	Subdivision	46	
7		47	
8		48	Improvements evaluation
9		49	
10		50	
11		51	
12		52	
13		53	
14	Name code (owner)	54	
15		55	Total evaluation
16		56	
17		57	Land use
18	Liber	58	
19		59	
20		60	No. of dwelling units (or tenants
21	Folio	61	where land use is non-residential)
22		62	Condition of property
23		63	
24	Lot	64	Zoning
25		65	Single/multiple use
26		66	
27	Block	67	
28		68	
29		69	
30		70	
31		71	
32		72	
33		73	
34	Acres or square feet	74	
35		75	
36		76	T/C
37		77	
38		78	Class
39		79	MLR
40		80	Control

Figure 5

PROPERTIES DATA LIST

Column		Column	
1	[illegible]	41	
2	Election district	42	
3		43	
4		44	Total evaluation (in $100's)
5		45	
6	Subdivision	46	
7		47	Value per square foot
8		48	
9		49	
10		50	
11		51	
12		52	
13		53	
14	Name code (owner)	54	
15		55	
16		56	
17		57	Land use
18		58	
19		59	
29		60	No. of dwelling units (or tenants)
21	Card number	61	where land use is non-residential)
22		62	Condition of property
23		63	
24	Supplemental parcel (000)	64	Zoning classification
25		65	Single/multiple use
26		66	
27	Block	67	
28		68	
29		69	
30		70	
31		71	
32		72	
33		73	
34	Square feet	74	
35		75	
36		76	
37		77	
38		78	
39	Land evaluation (in $100's)	79	Location
40		80	Deck number

Figure 6

contain a figure identifying the value per square foot. All of the items in columns 75 through 80 on the Assessor's card have been deleted, and columns 70 through 79 now contain a ten digit code identifying location, while column 80 has a number one (1), indicating that the card is part of the Properties Deck.

The location code will be taken from a 50 foot grid system centered on the Capitol Building and covering the entire metropolitan area (Map 1). The intersecting coordinates nearest the center of the property will identify its location, and this location will have to be determined and keypunched in a Properties card every time the extent of the property changes.

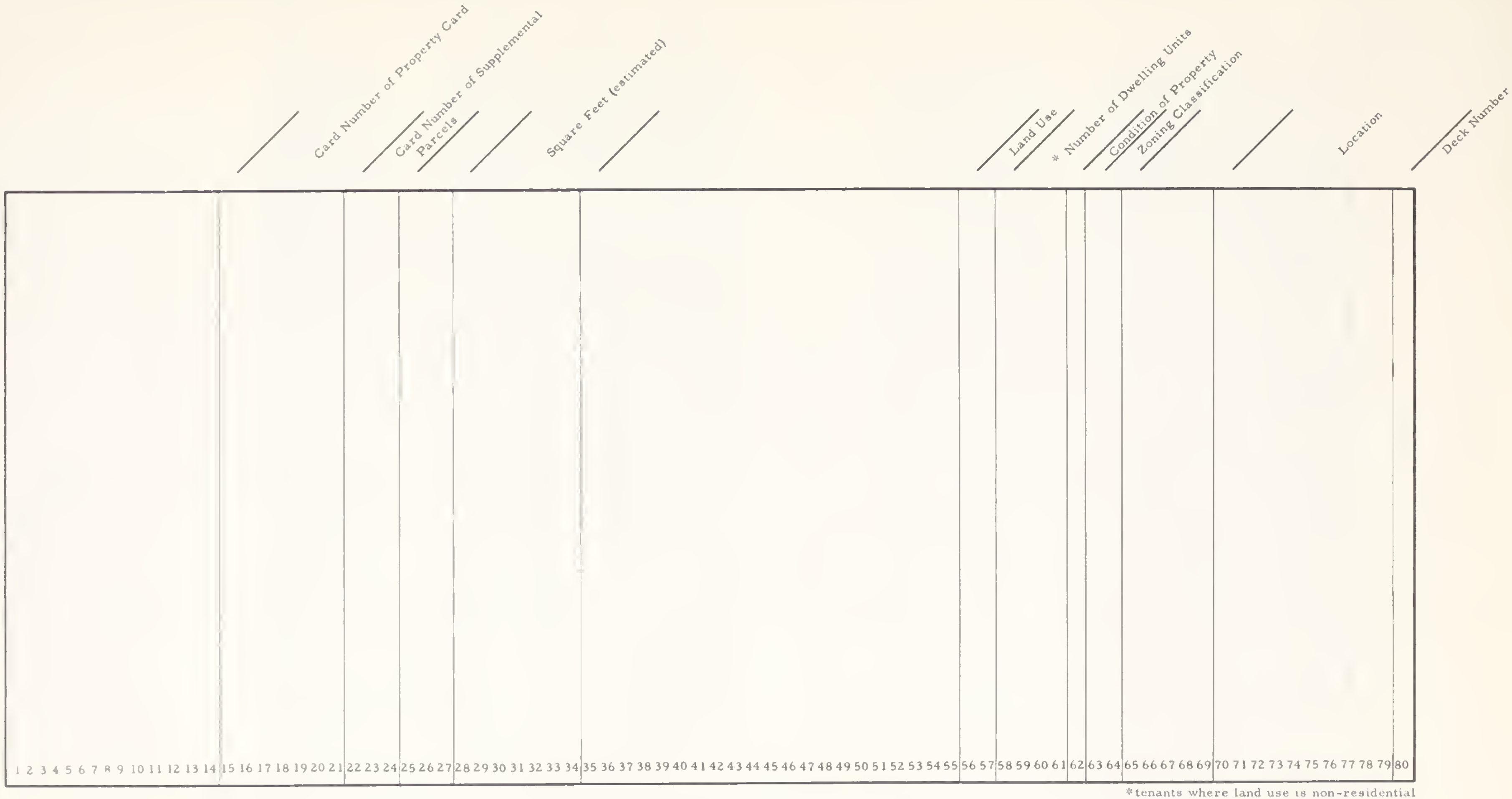
Storage and retrieval

The Properties Subdeck and the Supplemental Parcels Subdeck will be stored together and used together as the Land Use Deck. Therefore storage and retrieval procedures will be discussed as an aspect of the data processing procedure for both.

The Supplemental Parcels Subdeck

When column 65 on a Property card indicates multiple land use, that property will have to be classified according to the differing kinds of land use it supports. Each parcel of land supporting an individual category of land use will be represented by a data card (Figure 7) on which will be coded the following information:

Card Number of Property Card
Card Number of Supplemental Parcel Card
Square Feet
Land Use
Number of Dwelling Units
Condition of Property
Zoning Classification
Location
Deck Number



SUPPLEMENTAL PARCELS DATA CARD

Figure 7

Collection

Every Property card has a card number (Columns 15-21). Because each Supplemental Parcel card represents a portion of a property identified on one Property card, all Supplemental Parcel cards which "belong" to a particular property will be identified by the same property number, keypunched in the same columns of the card. But these additional cards must also be numerically differentiated, and therefore they will be numbered sequentially, using Columns 22-24, starting from one (1) for each property number for which there are Supplemental Parcel cards (Figure 8).

The information concerning parcels is collected by planning agency personnel in the field, using the coded information described under the preceding section of this report entitled "New Items on the Assessor's Card". Location is added for each parcel. The Deck Number is one (1), as it is for the Properties Subdeck, since these constitute the Land Use Deck.

Storage and retrieval

The Properties Subdeck and the Supplemental Parcels Subdeck are stored together as the Land Use Deck. When individual Property cards or Supplemental Parcel cards are changed in any way the old card will be destroyed and replaced by the new card, so that storage space requirements will not change radically over time. For an historical record of changes the entire Land Use Deck should be recorded on magnetic tape once a year. The tapes will be kept as a record of the land use "status" for a particular year. In any case, most forms of analysis are much more rapidly and effectively performed by computers using tape, so the "dual" record is not unusual.

Individual cards or groups of cards will be retrieved by machine, of course. The cards can be sorted in a wide variety of ways, and all cards in the system are related to each other by means of the location code.

SUPPLEMENTAL PARCELS DATA LIST

Column		Column	
1		41	
2		42	
3		43	
4		44	
5		45	
6		46	
7		47	
8		48	
9		49	
10		50	
11		51	
12		52	
13		53	
14		54	
15		55	
16		56	
17		57	Land use
18		58	
19		59	
20		60	No. of dwelling units (or tenants
21	Card number of property card	61	where land use is non-residential)
22		62	Condition of property
23		63	
24	Card number of supplemental parcels	64	Zoning classification
25		65	
26		66	
27		67	
28		68	
29		69	
30		70	
31		71	
32		72	
33		73	
34	Square feet (estimated)	74	
35		75	
36		76	
37		77	
38		78	
39		79	Location
40		80	Deck number

Figure 8

THE FAMILY CHARACTERISTICS DECK

Family characteristics information is collected by planning agency personnel. The data are collected by personal interviews and are recorded on a questionnaire form filled out by the interviewer. The people interviewed constitute only a "sample" of the total population.

Collection

The collection procedure for this information involves (1) determining the size of the sample, (2) selecting the respondents, (3) interviewing the respondents and filling in questionnaires, and (4) transmitting the information in coded form to a punched card.

Determining the size of the sample. The size of the sample will depend upon the degree of accuracy required of the data. An assumption has been made that for normal planning purposes it will be sufficient to be 95% certain that the error in the sample will be less than 5%. That is to say, one can be reasonably safe in assuming that the sample will truly represent the total family characteristics situation.

The population (that is, the total number of families) is quite certain to be large as compared with the size of the sample. Therefore, to determine the sample size the following formula will be used:

$$\sigma p = \sqrt{\frac{P\,(1-P)}{N}}$$

where: σp is the standard error of the sample proportion

P is the proportion of the population possessing the characteristic under study

N is the size of the sample

Thus there are three values, σ_p, P, and N, of which two must be known if the third is to be found. To determine N, then, one must specify the values of σ_p and P. P is unknown. If it were known, there would be no need to use a sampling procedure. However, σ_p is largest for P = 1/2. Therefore this value for P can be used, because using it can only result in calculating a sample of sufficient size, or larger, for the desired accuracy. σ_p is determined by the assumption that accuracy requirements will be satisfied by a 95% confidence of an error less than 5%. In other words, σ_p must be less than or equal to 2-1/2%. The sample size can then be computed as follows:

$$.025 = \sqrt{\frac{(1/2)\,(1/2)}{N}} = \sqrt{\frac{1}{N}}$$

$$.05 = \sqrt{\frac{1}{N}}$$

$$.0025 = \frac{1}{N}$$

$$N = 400$$

The value of N of course changes with changes in either confidence or accuracy limits. To illustrate:

For 99% confidence that the error will be less than 5%: N = 600
For 95% confidence that the error will be less than 3%: N = 1111
For 95% confidence that the error will be less than 1%: N = 10,000

This is a very small effort for a great deal of valuable information! (There are approximately 187,000 families in Montgomery and Prince George's counties.) A field test of the questionnaire brought responses from over 600 families at an average time expenditure per interview of something less than an hour. A sample consisting of 400 interviews would require, on the basis of the field test, about ten man-weeks of effort.

Selecting the respondents. Actual families to be interviewed are selected in the following way:

(1) From the Land Use Deck are sorted out all cards indicating residential land use. These cards are then separated into two decks, one containing all single-family residential use cards, and the other containing all multiple-family residential use cards.

(2) Establish the ratio between the number of single-family dwellings and the number of dwelling units in multiple-family dwellings, and distribute the sample proportionately between single-family units and multiple-family units. For example, if there are 7,500 single-family dwellings and 2,500 dwelling units (e.g., apartments) in multiple-family dwellings (e.g., apartment houses), the ratio is three to one. For a sample of 400 this would mean selecting 300 single-family dwellings and 100 multiple-family dwelling units.

(3) From a deck of random number cards, select 300 (i.e., the sample size) cards containing random numbers which fall within the range of card numbers assigned the single-family residential land use cards previously taken from the total Land Use Deck. Match the set of random number cards with the data cards. The specific dwelling units thus identified will constitute the sample.

(4) Using the deck of multiple-family cards, print out a cumulative total of dwelling units. For example:

Card 1 has 300 units --- cumulative total = 300
Card 2 has 200 units --- cumulative total = 500
Card 3 has 150 units --- cumulative total = 950
Card 4 has 50 units --- cumulative total = 1,000
Card 5 through Card n-- cumulative total = 2,500

Now, if the size of the multiple-family sample is to be 100, match the first 100 random numbers against the cumulative totals. For example, if a random number falls between one and 300, it is located in the multiple-family dwelling described on Card 1. If two or more random numbers fall between one and 300, the 300 apartment units of Card 1 are assigned numbers in sequence from

one through 300, beginning on the ground floor if the dwelling is multiple story, and the appropriate apartments thus numbered and matching the random numbers will be those selected for interview.

Interviewing the respondents. Information for the family characteristics survey is collected on a questionnaire form designed for the purpose (Figure 9). The boxes on the questionnaire coincide with columns on the data card (Figures 10 and 11). Coding is self-explanatory except for the following columns:

Columns 18-20 and 28-30: Vocation. This three-digit classification will be taken from the Dictionary of Occupational Titles, published by the U. S. Department of Labor. The interviewer will simply write down the occupations as told him by the respondent, and the coding will be done later.

Columns 52 and 53: Land Use. The appropriate classifications used for the Land Use Deck will be used. The interviewer should have a list of these and code the proper one during his visit.

Column 54: Condition of Property. This applies also to the Land Use Deck, and the same criteria will be used. The interviewer should code this during his visit.

Columns 70-79: Location. This will be determined from the address at the top of the questionnaire and the location map. It will be coded at a later date.

Column 80: Deck Number. This is Deck 2. The number will be printed on the questionnaire form.

Transmitting the information to a card. When the boxes on this questionnaire are completely filled in, a keypuncher can simply transfer the numbers to the appropriate columns on a card without any "translation".

Storage and retrieval

Since this information constitutes a sample, from which characteristics of the entire population are inferred, the generalizations about such characteristics will be retained, as will

Coding Sheet No. _____

FAMILY CHARACTERISTICS QUESTIONNAIRE

Street Address ____

Columns	Code		Description
1-2	☐☐	1-5	
3-4	☐☐	6-10	
5-6	☐☐	11-15	
7-8	☐☐	16-20	No. of members of
9-10	☐☐	21-40	specified age groups
11-12	☐☐	41-60	in family
13-14	☐☐	61 and over	
15-16	☐☐	Total	
			Head of Household
17	☐	(a) Sex (M or F)	
18-20	☐☐☐	(b) Vocation ____________	
21-23	☐☐☐	(c) Time of travel to job in minutes	
24	☐	(d) Method of travel: (1) private; (2) public; (3) car pool; (4) self-propelled	
25-26	☐☐	(e) Length of vacation in days	
			Second Employed Member
27	☐	(a) Sex (M or F)	
28-30	☐☐☐	(b) Vocation ____________	
31-33	☐☐☐	(c) Time of travel to job in minutes	
34	☐	(d) Method of travel: (1) private; (2) public; (3) car pool; (4) self-propelled	
35-36	☐☐	(e) Length of vacation in days	

Figure 9

Coding Sheet No. ______

Family Characteristics Questionnaire, page 2

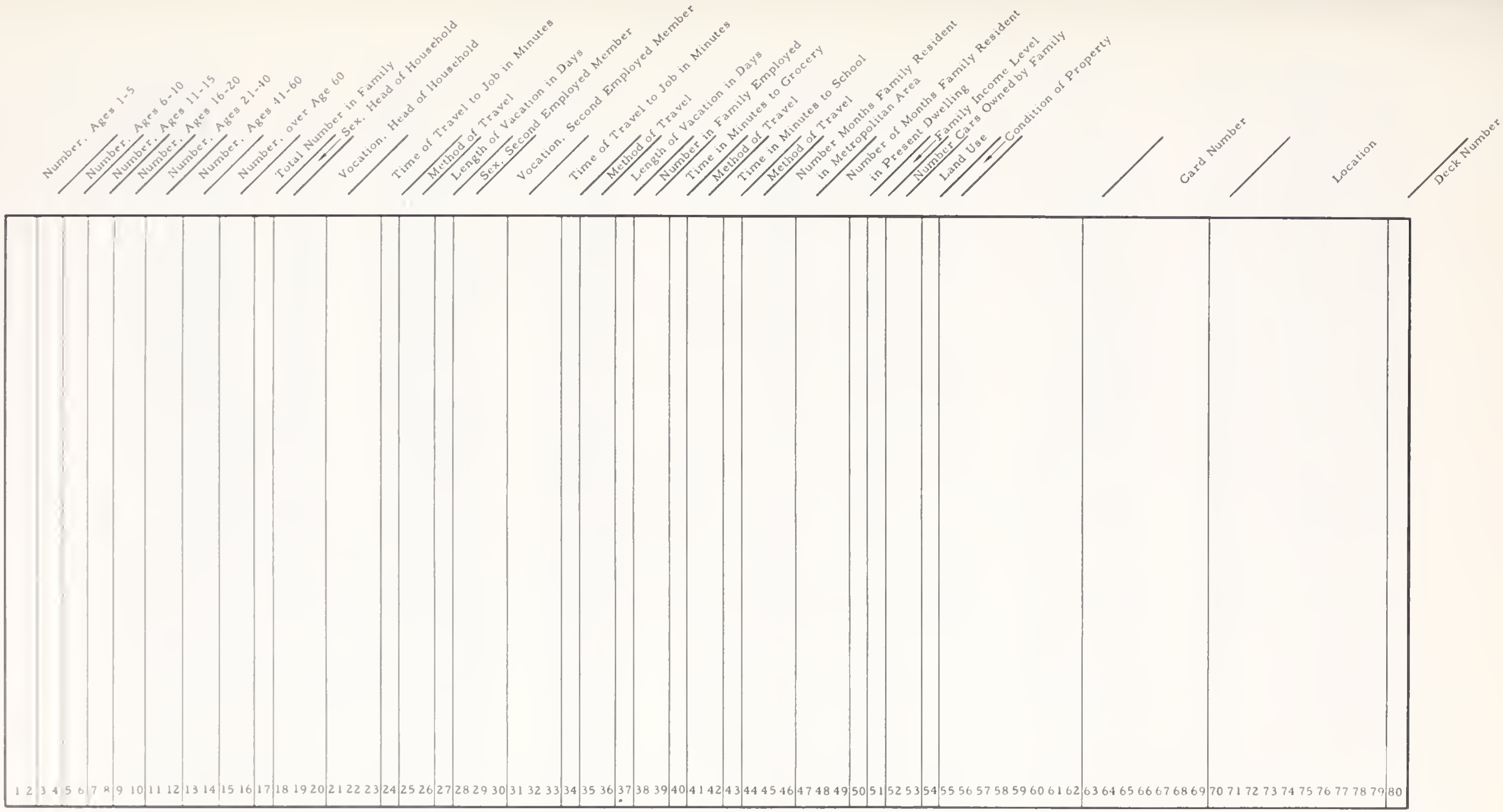
Columns	Code	Description
37	☐	Number in family employed
38-39	☐☐	Time in minutes to grocery
40	☐	Method of travel (code as before)
41-42	☐☐	Time in minutes to school
43	☐	Method of travel (code as before)
44-46	☐☐☐	No. of months family resident in metropolitan area
47-49	☐☐☐	No. of months family resident in present dwelling
50	☐	Family income level: (1) 0-4,999; (2) 5,000-9,999; (3) 10,000-14,999; (4) 15,000-19,999; (5) 20,000 +
51	☐	No. of cars owned by family
52-53	☐☐	Land Use (Land Use Deck code)
60	☐	Condition of Property: (1) sound; (2) deteriorating; (3) dilapidated
70-79	☐☐☐☐☐☐☐☐☐☐	Location
80	2	Deck Number

Date data gathered ________ Interviewer ______________________________

FAMILY CHARACTERISTICS DATA LIST

Column		Column	
1		41	
2	No., Ages 1-5	42	Time in minutes to school
3		43	Method of travel
4	No., Ages 6-10	44	
5		45	No. of months family resident in
6	No., Ages 11-15	46	metropolitan area
7		47	
8	No., Ages 16-20	48	No. of months family resident in
9		49	present dwelling
10	No., Ages 21-40	50	Family income level
11		51	No. cars owned by family
12	No., Ages 41-60	52	
13		53	Land use
14	No., over age 60	54	Condition of property
15		55	
16	Total no. in family	56	
17	Sex, head of household	57	
18		58	
19		59	
20	Vocation, head of household	60	
21		61	
22	Time of travel to job	62	
23	in minutes	63	
24	Method of travel	64	
25		65	
26	Length of vacation in days	66	
27	Sex, second employed member	67	
28		68	
29		69	Card number
30	Vocation, second employed member	70	
31		71	
32	Time of travel to job	72	
33	in minutes	73	
34	Method of travel	74	
35		75	Location
36	Length of vacation in days	76	
37	No. in family employed	77	
38		78	
39	Time in minutes to grocery	79	
40	Method of travel	80	Deck number

Figure 10



FAMILY CHARACTERISTICS DATA CARD

Figure 11

mapped distributions, but the cards themselves will be of no particular historical value because the cards of subsequent samples will not consist of the same actual families. Therefore the specific units of data, the data cards representing individual families, cannot be directly compared and will not be kept from year to year. However, the analyses of the sample data will of course be kept and compared with subsequent analyses, for this will be a valid comparison.

Thus these data represent no storage or maintenance problem. Analysis of the information will be more expeditious on a computer, and very probably the information on this deck of cards will therefore be transferred to tape.

THE EMPLOYMENT CHARACTERISTICS DECK

Employment characteristics information is collected by planning agency personnel. The data are collected by personal interviews and are recorded on a questionnaire form filled out by the interviewer. The employers interviewed constitute only a "sample" of the total population.

Collection

The steps in the collection procedure for this information are exactly those described for collection of the family characteristics data.

Determining the size of the sample. The total number of employers is large in comparison to the sample size -- that is to say, it is likely to be 20 or more times greater than the sample -- and therefore the formula applied to the family characteristics sample is also applicable here.

Selecting the respondents. Actual employers to be interviewed are selected in the following way:

(1) From the Land Use Deck, select all data cards showing the following categories of land use: commercial, industrial, transportation, institutional, educational, and public service (excluding residential, agricultural, and no activity data cards).

(2) From a deck of random number cards, select cards, equalling the size of the sample, which fall within the range of card numbers assigned the selected deck and match the set of random numbers with the data cards. The specific "employers" thus identified will constitute the sample.

(3) For all buildings with multiple business firms, use the system suggested in step (4) of the Family Characteristics Survey.

Interviewing the respondents. Information for the employment characteristics survey is collected on a questionnaire designed for the purpose (Figure 12). The boxes on the questionnaire coincide with columns on the data card (Figures 13 and 14). Coding is self-explanatory except for the following columns:

Columns 1-4: Employer. The interviewer will write down a name describing the nature of the business, and this will later be assigned a four-digit code number taken from the Standard Industrial Classification, published by the U. S. Bureau of the Budget.

Columns 12-14, 15-17, and 18-20: Occupational Titles. The interviewer will write down a name describing the nature of the occupation, and this will later be assigned a three-digit code number taken from the Dictionary of Occupational Titles, published by the U. S. Department of Labor.

Columns 38-45: Name Code (Firm). This is simply a sequential numbering system placed on each questionnaire and duplicated on the card for purposes of referring back to the questionnaire if necessary.

Columns 70-79: Location. This will be determined from the address at the top of the questionnaire and the location map. It will be coded at a later date.

Column 80: Deck Number. This is Deck 3. The number will be printed on the questionnaire form.

Transmitting the information to a card. When the boxes on this questionnaire are completely filled in, a keypuncher can simply transfer the numbers to the appropriate columns on a card without any "translation".

Coding Sheet No. _____

EMPLOYMENT CHARACTERISTICS QUESTIONNAIRE

Name of Employer ____

Street Address ____

Columns	Code	Description
1-4	□□□□	Employer (Standard Industrial Classification) ______________________
5-9	□□□□□	Number of Employees
10-11	□□	Per cent of employees male
12-14	□□□	Occupational title of largest employed group: ______________________
15-17	□□□	Occupational title of second largest employed group: ______________________
18-20	□□□	Occupational title of kind of employee most difficult to find: ______________________
21-23	□□□	Median employment period, in months
24-27	□□□□	Median monthly salary (if applicable)
28-31	□□□□	Median hourly wage (if applicable)
32	□	Employment peak: (1) spring; (2) summer; (3) fall; (4) winter; (5) none
33	□	Employment low: (1) spring; (2) summer; (3) fall; (4) winter; (5) none
34-35	□□	Per cent "input materials" from within metropolitan area
36-37	□□	Per cent of "market" within metropolitan area
38-45	□□□	Name code (firm) ______________________
46-47	□□	Number of locations within metropolitan area
48-50	□□□	Months in business (life of firm)
51-53	□□□	Months in metropolitan region
54-56	□□□	Months at same location
70-79	□□□□□□□□□□	Location
80	□	Deck Number

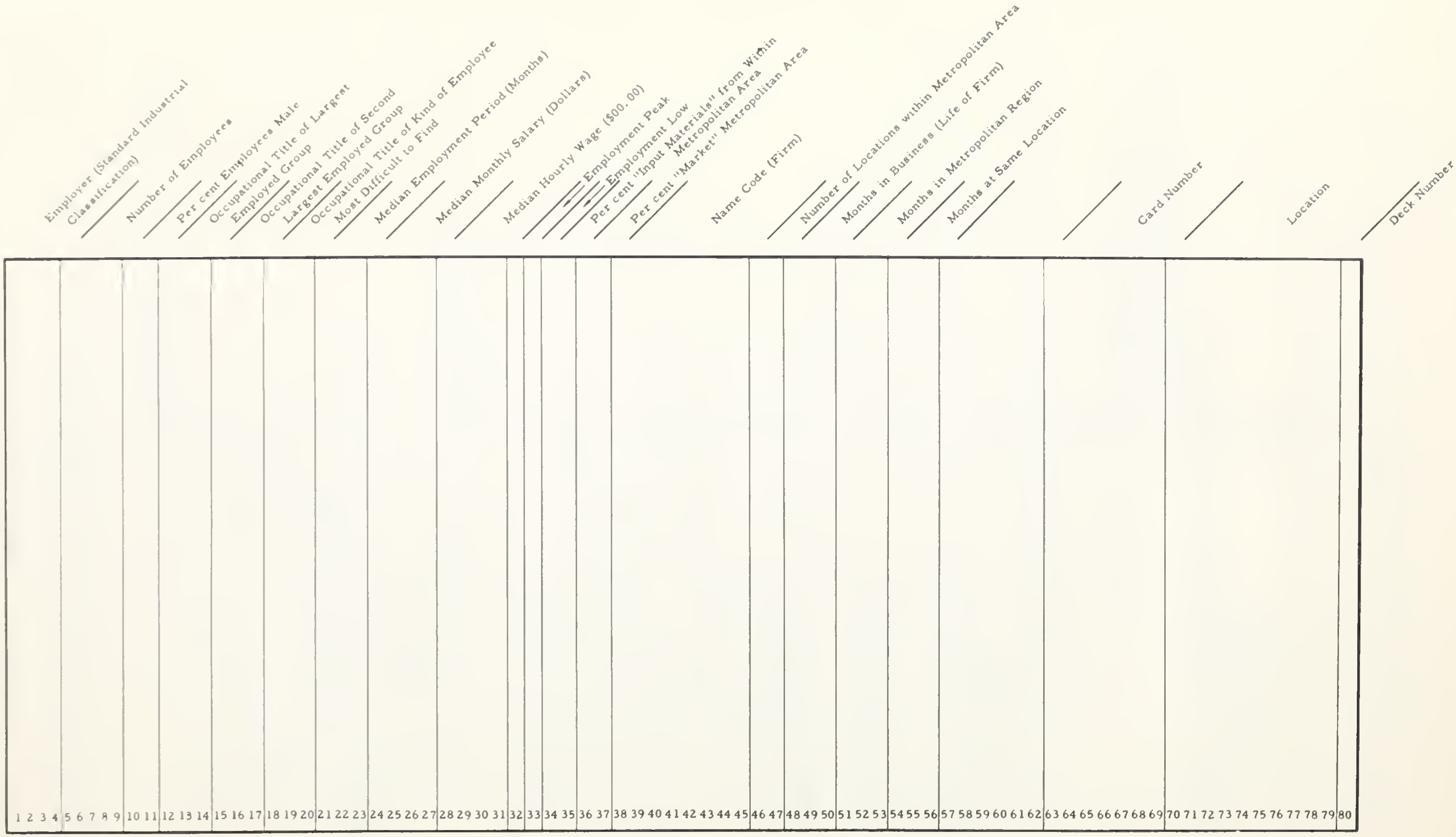
Date data gathered ____________ Interviewer ______________________

Figure 12

EMPLOYMENT CHARACTERISTICS DATA LIST

Column		Column	
1		41	
2		42	
3	Employer (Standard Industrial	43	
4	Classification)	44	
5		45	Name code (firm)
6		46	Number of locations within
7		47	metropolitan area
8		48	
9	Number of employees	49	
10		50	Months in business (life of firm)
11	Per cent employees male	51	
12	Occupational title (USDL occu-	52	
13	pational classification) of largest	53	Months in metropolitan region
14	employed group	54	
15	Occupational title (USDL occu-	55	
16	pational classification) of second	56	Months at same location
17	largest employed group	57	
18	Occupational title (USDL occu-	58	
19	pational classification) of kind of	59	
20	employee most difficult to find	60	
21		61	
22	Median employment period	62	
23	(months)	63	
24		64	
25		65	
26		66	
27	Median monthly salary (dollars)	67	
28		68	
29		69	Card number
30		70	
31	Median hourly wage ($00.00)	71	
32	Employment peak	72	
33	Employment low	73	
34	Per cent "input materials" from within	74	
35	metropolitan area	75	
36	Per cent "market" within	76	
37	metropolitan area	77	
38		78	
39		79	Location
40		80	Deck number

Figure 13



EMPLOYMENT CHARACTERISTICS DATA CARD

Figure 14

Storage and retrieval

This is a sample, just as is the family characteristics survey. The data will be analyzed but the cards will not be kept.

ANALYSIS AND APPLICATION

An information system such as the one described in the preceding pages has a tremendous "potential" for analysis and application. Continuing use will reveal more and more of its utilities, and in turn modify the system to make it more effective. However, the system was designed to meet some very basic needs, and the following suggestions for analysis and application relate directly to these needs.

Establishing Planning Goals

Goals for planning depend upon a knowledge of existing standards. Existing standards are identified by the information system. For example, value per square foot of differing categories of land use may well be an important indicator of standards.. That is to say, given the total range of values per square foot for each specific form of land use (row house residential, garden apartment residential), one can derive mean values and distributions of values as indicators of what conditions are average (standard), below average (substandard), and above average (above standard). Because this indicator is based on the Land Use Deck, it is also possible to compare values for similar land uses from one part of the city to another. It should be particularly valuable to the Assessor to be able to analyze the relationship between the judgment on Condition of Property and the Value per Square Foot for various kinds of land use and for a given kind of land use in different parts of the city.

Both of the sample surveys are designed to produce specific measures of actual conditions of shelter, supplies, facilities and services, and employment. They are not designed to measure every condition, of course. They are designed to give the planner significant indicators by which standards can be established. For example, travel time budgets and methods of travel to work, to

the grocery store, and to school <u>combine</u> information about availability of supplies (grocery) and facilities (school) with a measure of the relationship between where people live and where people work; they will also show preferences in modes of travel, the amount of time each day people spend in transit, and the travel times people have accepted. The variety of analyses these few items of information invite is limited only by the planner's imagination.

The basic point to be made here is that the planner will, however he decides to analyze these data, be able to give elected officials specific factual, and current, information about the status of people and their activities in the city. With this information before them, officials will be better able to make judgments about what the status <u>ought</u> to be.

In addition to this, the planner here has a unique tool for attacking his spatial problems. Every card in the Land Use Deck has a statement about Condition of Property. This is basically quite simple; it amounts to a statement that there are no buildings, or that the buildings are sound, deteriorating, or dilapidated. (Even if the classification is changed and made more detailed, the application will be the same.) This information can be "printed out" by machine. For this particular purpose the rows of the print out will be considered lines of latitude and the columns lines of longitude, each designated according to a number on the location grid (Map 1). At every "intersection" for which there is a data card, that is, at the grid-identified center of every property or parcel. the machine will print a symbol indicating condition of property. The printed sheet will then be a plotted map which can be compared with either aerial photographs or maps, thus identifying substandard areas.

The same thing can be done for the values of anything which have been judged to be low enough to be substandard. For example, it may be decided that Value per Square Foot for Row Houses, Residential below a given figure is substandard. The occurrence of such low values can be plotted by location. The combinations of such measures will clearly indicate substandard areas. These can then be studied in greater detail to determine in which specific respects they are substandard and what needs to be done to upgrade them.

In fact, one has here the basis for delineating functional planning regions. All substandard regions constitute areas of needed renewal. Regions that are not substandard by these measures can be regarded as status quo -- that is, not in need of immediate attention. Status quo regions can further be classified on the basis of how they compare with the mean; they must either be average, above average, or below average but not enough below average to be classed as substandard. Areas not now used for urban functions (agricultural and vacant land, for example) can be classified as being "available for new urban uses". Thus the information system immediately, and to a large extent mechanically, identifies the basic spatial planning situations: areas that must be improved at once, areas that are approaching that stage, areas that provide no concern except upkeep, and areas that can be devoted to more intensive urban uses now and in the future.

Constructing Realistic Models

The design of a plan depends upon an intimate functional and spatial knowledge of the urban place. A city can be described as a system occupying a certain space and related to other systems; that is to say, the parts of a city are functionally interrelated to the extent that a single change in one part of a city or in one of the functions of a city may well have profound effects in other areas and on other functions. For example, upgrading of substandard residential areas (slums) generally means associated problems of resettlement, employment, such welfare activities as adult education, and the like. Therefore, the planner should be able to anticipate all of the effects that will result from introduction of any given action portion of a plan. If some of the effects are undesirable, he should be able to modify his plan or his program to eliminate those effects. In other words, he needs some kind of "working" model or models as the basis for creation and evaluation of the design of his plan. The model for his city depends upon information about his city. In fact, models are so important that they will be more fully discussed in a later chapter.

Planning administration depends upon such devices as subdivision regulations and zoning ordinances. It therefore depends upon specific, detailed information about the city. This information is needed often and it must be highly accessible. The Land Use Deck was designed to provide the information needed in detail constantly and quickly, without adding an intolerable burden of additional expense to the planning operation. For example, the Land Use Deck identifies both Land Use and Zoning. Thus all properties and parcels with nonconforming use can be sorted out, listed, and classified in a variety of ways. Not only can they be identified, but the patterns and trends of nonconforming use can be studied as a basis for improved methods of implementation.

MACHINE INSTALLATION REQUIREMENTS

Any information system of this sort obviously depends upon the use of the appropriate machines. The information in this system is designed to be collected in such a fashion that it can be coded and keypunched on cards. Any agency which originates basic data cards ought, then, to have the equipment necessary to produce them -- specifically: printing key punch machines, verifiers, and reproducing punch machines. Beyond these, it is more and more the case that both simple and complex programs of analysis can best be accomplished by computers. For example, to use the card decks in some of the basic ways indicated in this chapter one would need a sorter, collator, and tabulator. However, all of these functions, and many more, can be accomplished by a computer. Just how a given agency will solve this problem of mechanization depends entirely on the local situation, and it is therefore impossible to generalize about machine requirements.

CHAPTER 5. DESCRIPTION OF THE VISUAL INFORMATION SYSTEM

Urban planners rely heavily on maps and photographs in every stage of the planning process. They deal with urban spaces and their uses, and a very important ingredient of the planning art is a basic visual comprehension of space relationships.

THE USE OF VISUAL INFORMATION IN THE PLANNING PROCESS

It is unquestionably the case that one can look at things distributed in space -- for example, houses in a subdivision -- and draw some conclusions, conscious or unconscious, about the "spatial structure". This is, at its simplest, a visual appreciation of areal extent and the juxtaposition of things in space; "Your house is a block from mine, downhill, and faces west while mine faces north." More complexly, it is an appreciation of functional relationships between and among things in space: between roads and valleys or, conversely, roads and interfluves; between farmhouses and crossroads; among such things as terrain, single-family residences, distance from employment centers, and patterns of transportation. When a planner looks at a series of maps and photographs and "feels" that a certain design would be appropriate for a developing city, he is making a judgment based on an implicit, intuitive appreciation of the spatial structures he sees as

something much more than a number of characteristics added one to the other. In effect his eye and mind are collating the events of a complex and dynamic scene, seeing them in an orderly, rather than disorderly, fashion, and storing some generalizations which will be retrieved whenever a reasonably similar array of visual information is presented to him.

It becomes very important, therefore, to enhance this intellectual process as much as possible. Seeing is a very severely limited perceptory device. But man has learned to extend the normal limits of his vision by means of such instruments as the telescope and microscope. He has also learned to "see" large earth spaces by means of visual representations. Maps, photographs, and models which "represent" areas too large for man to see physiologically can also be used in more subtle ways. They permit man to visualize things that normally cannot be seen, such as: air temperatures, water tables, and soil types. They also permit him to visualize things which do not exist: proposed highways, new shopping centers, and designs for urban renewal. And perhaps one of their most valuable adjuncts is simplicity. A map may show only sewers, or only roads and sewers, and one can concentrate on a single problem without being overwhelmed by the entire universe of visual information.

In short, maps and photographs have a tremendous potential for enhancing the process of "visual collation". Summarized, their qualities useful to planning are the following:

(1) They make it possible for the planner literally to "see" his entire city or segments of it by representing a segment of the real world at a scale comprehensible to the human eye.

(2) They are super-realistically n-dimensional. On them one can portray any number of coexisting things, from such tangible, seeable things as roads and rivers, to such unseen things as wind direction and population density, to such non-existent things as contemplated structures.

(3) They provide both real and imagined perspective. A model may show terrain, sub-surface structures, and super-surface structures.

(4) They provide visualization in a wide variety of useful ways. They can be put on a floor or table or wall; they can be projected. They can be arranged side-by-side; they can be superimposed; they can be reduced and enlarged. This tremendous versatility both of medium and of method of portrayal unquestionably gives depth and breadth to the visual impression of spatial relationships.

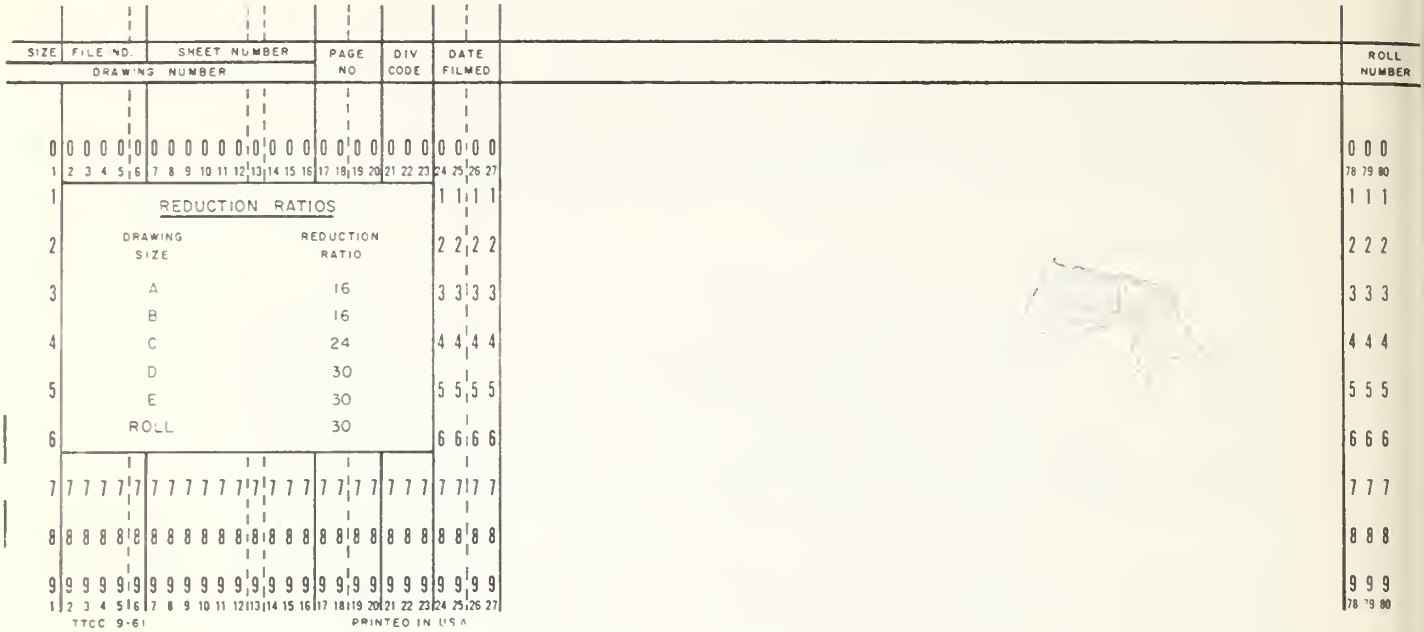
Such tremendously useful tools of the planning process ought to be used as effectively as possible. They can be used more effectively if the form of their collection, storage, and retrieval is made as widely flexible as possible. And to do this means to introduce automatic data processing methods and devices, essentially as had been the case in the use of numerical data.

AN AUTOMATED VISUAL DATA PROCESSING SYSTEM

The essential difference between numerical data and visual data is that the information "element" is in one case a number and in the other case a picture of some sort. In both cases the information can be put on a data card. And in both cases the data card can be used in a mechanical system which greatly speeds up and generally facilitates data processing. The data card for visual data processing has a window in which a positive or negative film is placed. It has room for numerical information, and it is the same size as the numerical data card (Figure 15). It can therefore be integrated into the overall automatic data processing system. However, its use is relatively new, and the gadgetry involved is much less well known than are the machines for numerical data processing. Therefore a general description of equipment needs will follow the discussion of the methods and procedures of collection, storage and retrieval, and analysis of visual information.

Collection

There are three kinds of visual information which are absolutely essential to the planning process: aerial photographs, property maps, and topographic maps. The entire planning region should have complete coverage by all three at the same scale; the basic scale used by Maryland-National Capital Park and


SIZE
FILE NO.
SHEET NUMBER
DRAWING NUMBER
PAGE NO
DIV CODE
DATE FILMED
ROLL NUMBER
REDUCTION RATIOS
DRAWING SIZE
REDUCTION RATIO
A 16
B 16
C 24
D 30
E 30
ROLL 30
TTCC 9-61
PRINTED IN USA

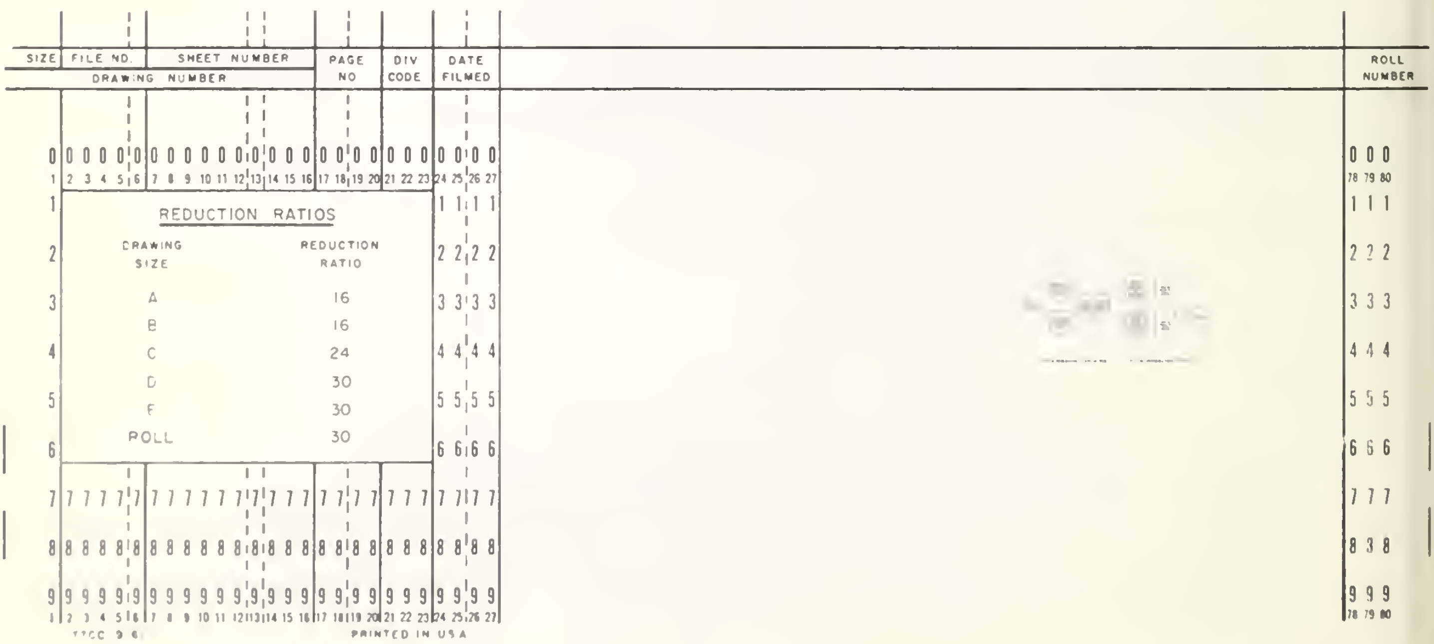

SIZE
FILE NO.
SHEET NUMBER
DRAWING NUMBER
PAGE NO
DIV CODE
DATE FILMED
ROLL NUMBER
REDUCTION RATIOS
DRAWING SIZE
REDUCTION RATIO
A 16
B 16
C 24
D 30
E 30
ROLL 30
PRINTED IN USA

Figure 15

Planning Commission planners is 1" = 200'. Areas of considerable change should be photographed annually. The cost is not prohibitive; a commercial firm could photograph the area and provide the planning agency with prints at a scale of 1" = 200' for less than $10,000. Property maps are produced by the Assessor's Office at both 1" = 200' and 1" = 600'. It is so evident that information exchange between Assessor and planner will be profitable to both that coordination of the visual information system, as well as of the numerical information system, is recommended. Topographic maps need be produced only once, in most cases, and the agency which assumes the responsibility for this undertaking varies greatly from one jurisdiction to another; responsibility for these maps becomes a matter of local decision.

The three basic visual representations form the basis for all other information in the visual system. For example, on the topographic maps should be plotted such related information as water tables, soil conditions, and Master Plans. Land use regions and planning regions should, for most effective presentation, be superimposed on aerial photographs. Zoning should be superimposed on property maps, for obvious reasons, but could also usefully be superimposed on land use maps. All basic maps here indicated should be at the same scale, 1" = 200', so that all can be directly compared -- a process made effective by automation.

In summary form the visual system will contain at the very least the following information:

<u>Aerial photographs</u> (1)

AND, superimposed on these: <u>land use maps</u> (1a)
<u>planning region maps</u> (1b)

AND, superimposed on land use maps: <u>zoning maps</u> (1a1)

<u>Topographic maps</u> (2)

AND, superimposed on these: <u>physical site qualities maps</u> (2a)
<u>Master Plan maps</u> (2b)

Property maps (3)

AND, superimposed on these: zoning maps (3a)

This adds up to more than nine different classes of maps, all at the same scale and affording complete coverage of the area. It does not preclude the use of the same classes of maps at other scales; nor does it preclude the use of other classes of maps. The objective here is to point out what is essential to the planning process and must be included in the system, not to exclude any visual information which a particular planner finds useful and necessary.

Collection of information for the three basic elements of the visual system (1, 2, 3) has already been discussed. Of the subsidiary groups, planning region maps (1b), zoning maps (1a1 and 3a), and Master Plan maps (2b) will originate with the planning agency. Land use maps (1a) can either be produced by the planning agency, by using the Land Use Deck of numerical data, or they can be produced by photo-interpretation. If land use classes are generalized, and if map detail does not extend to small individual parcels, the latter process is undoubtedly much faster and less expensive. Which system is used depends upon the methods of the individual planner. Very much the same general principle applies to the production of maps showing physical qualities of the site. Planners differ in the degree of detail they want, concerning soil characteristics for example, before they create a Master Plan for an area. But such information is often produced by other agencies and should be borrowed and put into the planner's information system if it is suitable. Very probably the systematizing of visual information will have much to do with both increased use and wider inter-agency exchanges of visual materials.

"Processing" the original data

The above categories of maps are "reduced" to standard units of information, capable of machine processing, by photography. This process is shown diagrammatically in the left-hand side of Figure 16. The unit of information in this case is a 35mm X 46mm film of the original map or photograph. The film is

attached to a data card which has an aperture for this purpose. The aperture card also has space for numerical information in the form of keypunches. The map or photograph mounted on the aperture card can thus be identified by numerical codes: the class of map, the map scale, the location (the grid identification used on all data cards in the system), a card number, and a deck number (Figure 17).

Coding the visual deck

Numerical designations for the above information are not complicated, and the following coding systems have been devised:

Class of map. Two digits are used to permit inclusion of any other types of maps:

10 ----- Aerial photographs
11 ----- Aerial photographs + land use
12 ----- Aerial photographs + planning regions
13 ----- Aerial photographs + land use + zoning

20 ----- Topographic maps
21 ----- Topographic maps + soils
22 ----- Topographic maps + ground water

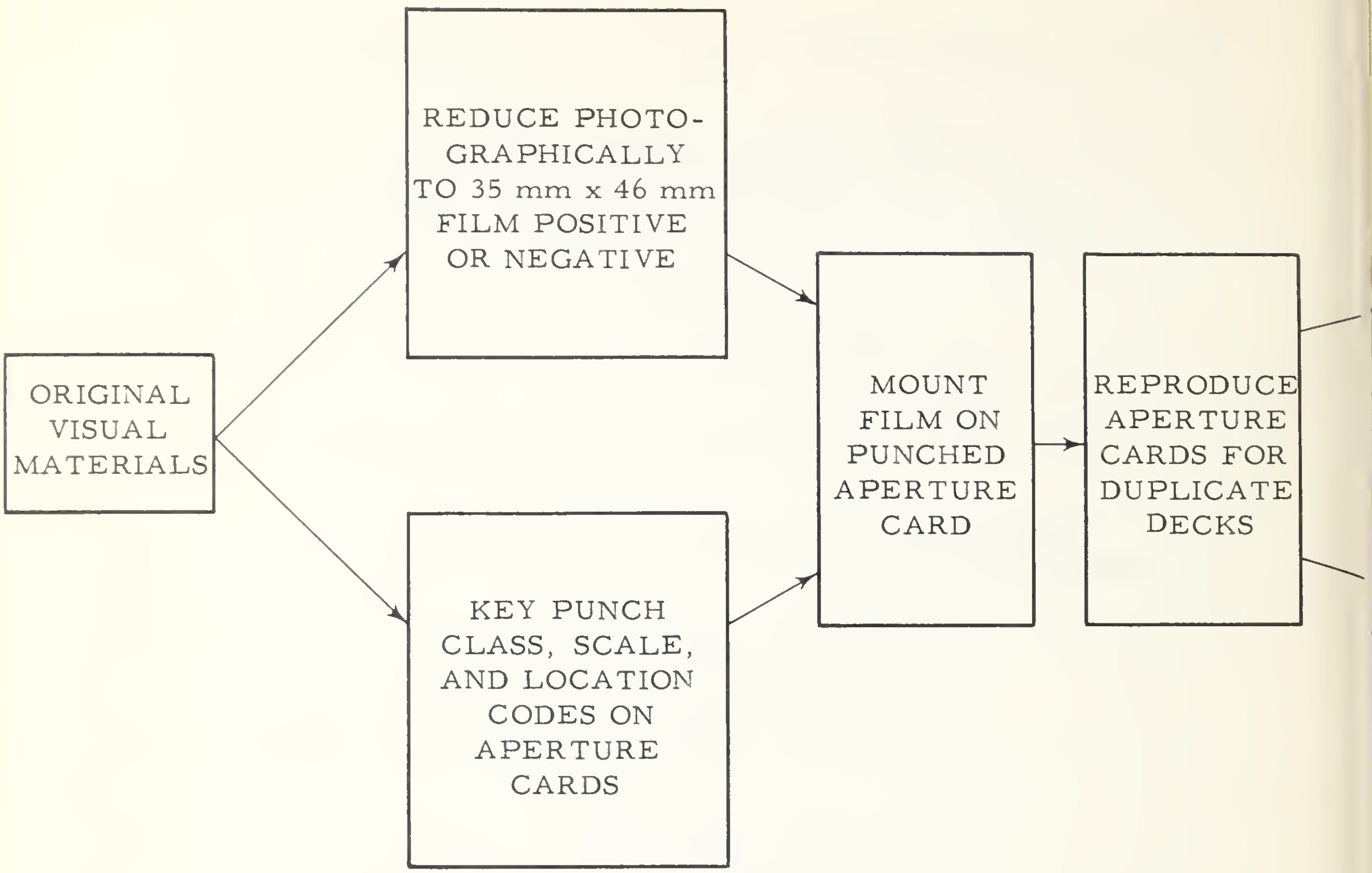
28 ----- Topographic maps + Master Plans

30 ----- Property maps
31 ----- Property maps + zoning

Scale. All scales will be stated as a ratio of inches to feet, and the coding will mean that one inch equals the number of feet punched into the card. Six digits have been allocated to scale, the assumption being that 1" = 999, 999 feet would be the smallest scale ever included in the system.

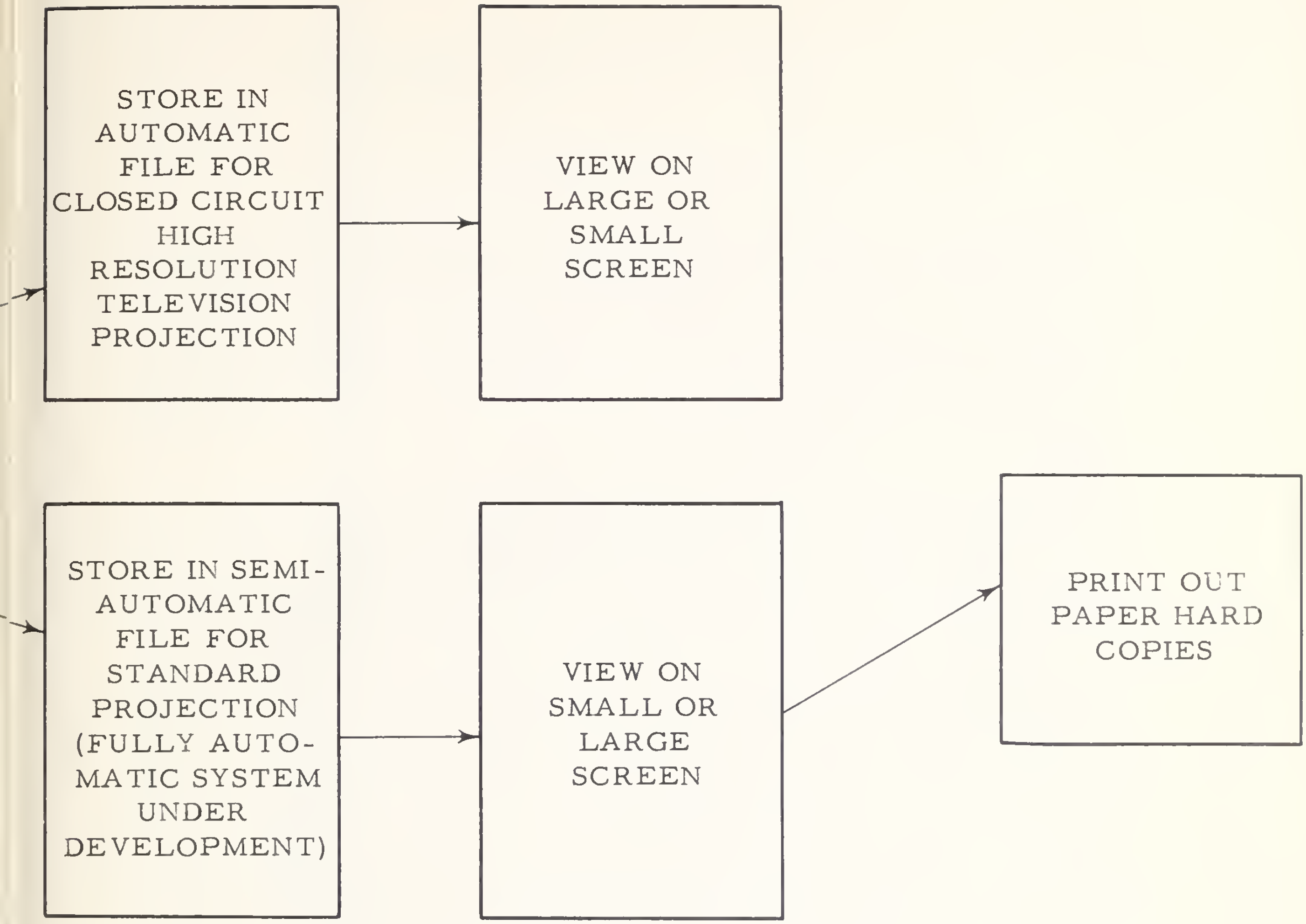
Card Number. This is simply sequential numbering of all cards in the visual information deck for "housekeeping" purposes.

Location. The central point on the map will be identified as an intersection in the metropolitan grid system used to locate all units of data in the entire information system.



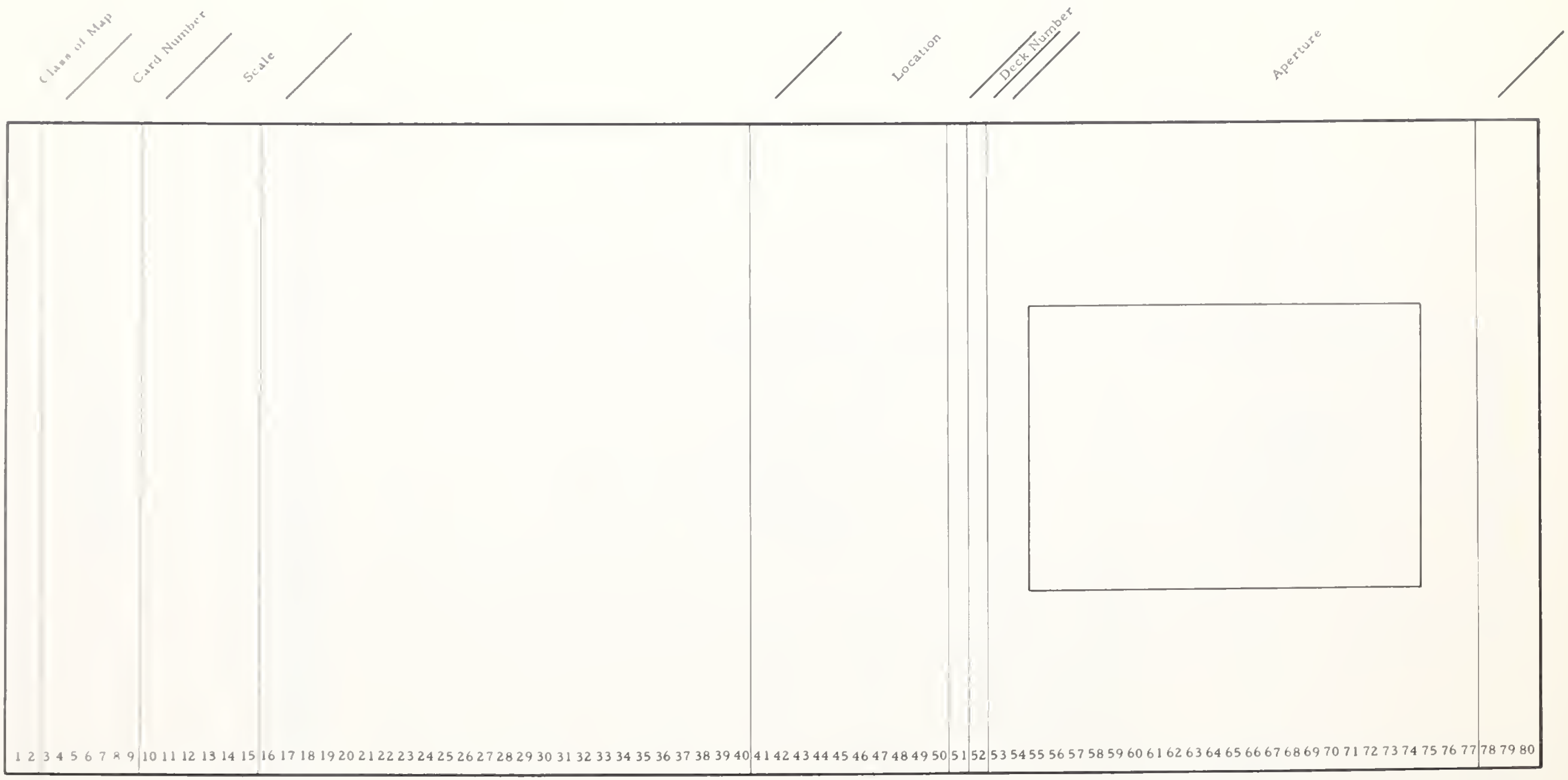
DATA PROCESSING STEPS IN THE

Figure 16



VISUAL INFORMATION SYSTEM

Figure 16



APERTURE DATA CARD

Figure 17

Deck Number. The deck number is three (3).

Storage and Retrieval

Inaccessibility of visual materials has been the major limiting factor in their use. Maps and photographs are bulky, awkward to handle and to view, and occupy tremendous amounts of storage space. In this system, reduced to the size of punched data cards, they become as manageable as the elements of an automatic numerical information system. (See right-hand side of Figure 16).

Aperture cards can be stored in a variety of ways, but since they must be "viewed", it is recommended that they be stored in cabinets which will "retrieve" and project them automatically. There are now in production such cabinets which will store 5,000 cards, retrieve them in an average time of two and one-half seconds (by means of a four-digit address), and position them in the field of a lens system, either for standard projection or for television projection. There is available also a "reader-printer" which projects an 18" X 24" image on a screen and which also prints out a paper copy of the image projected. In general, all of the machines involved in such a system cost much less than does the equipment required for the numerical data processing system. The entire mechanical system is described, and costs of equipment estimated, at the end of this chapter.

It is estimated that the Maryland-National Capital Park and Planning Commission has a total of about 3,000 maps of all varieties. To put these on aperture cards would be relatively inexpensive and would make them several thousand times more available than they are at present.

Analysis

Analysis of visual information is essentially still an art. That is to say, it is a much less objective and explicit process than are those involving analysis of numerical information. It is basically an implicit "visual appreciation and coordination" so essential to planning, a storehouse of knowledge the mathematical

model-builders would like to tap; making explicit much of what is now implicit. Any use of visual materials that can facilitate this process, that can heighten and stimulate it, is desirable. The treatment of visual information outlined here should contribute to analysis in two ways:

(1) It will make immediately available, for group or single viewing, any piece of visual information the planner has.

(2) It will coordinate all visual information with all numerical information by means of the location codes. Therefore, the planner can get quick summaries of various kinds of numerical information about an area and coordinate them with the visual image.

MACHINE INSTALLATION REQUIREMENTS

Almost the entire "processing system" for visual information is mechanized. The machine requirements can then be stated in terms of the processes involved (Figure 16). No "brands" of machines are identified. The equipment described is illustrative of what is available in the market.

Reproducing Original Materials on Film

Processing procedures vary with the nature of the original material. Line drawings need only to be photographed and reproduced as negative transparencies. Half-tone and continuous tone originals must be made into positive transparencies. Color originals should probably be processed as film positives, then contact printed on a fine grain film, and processed in black and white, if paper "hard copies" are to be required. The same camera can be used to photograph all of these originals. No great skill is required to operate the various pieces of equipment used.

Equipment

There are three basic elements of equipment: camera. film processor, and printer. A variable focus 35mm planetary

camera will photograph original materials with dimensions up to 37-1/2 X 52-1/2 inches. One such camera has dimensions of 102 X 72 X 34 inches, is largely automatic, will rotate through 360^{o} to photograph materials vertically or horizontally, and costs approximately $2,500.

Processors for 35mm film will make black-and-white negative and positive film prints of line, half-tone, and continuous tone originals. Processors are generally designed to feed exposed film continuously through all of the normally required stages of developing, washing, drying, and rewinding. One commercial processor has dimensions of 76 X 24 X 72 inches, a top operating speed of 50 feet per minute, and costs approximately $5,000.

Contact printers for 35mm film will make black-and-white positive transparencies of half-tone and continuous tone negatives and will print black-and-white negatives from color positive transparencies. One commercial printer has dimensions of 28 X 28 X 16 inches, a top printing speed of 50 feet per minute, and costs approximately $2,000.

Coding Aperture Cards

The aperture card must be keypunched with the information described previously. The procedure is to punch the information on ordinary cards, which are then verified and automatically reproduced on the aperture deck. The aperture cards and the material coded on roll film should be given identical sequential numbers, so that cards and film "match" for the mounting process.

Mounting Film on Aperture Cards

Film is mounted on aperture cards by machines which are operated either manually or semi-automatically, thus verifying the relation of coded card to film in a rapid process. Hand-operated mounters can convert roll film to aperture cards at a rate of 300 to 600 frames an hour. A manually operated mounter weighs about 13 pounds, has dimensions of 6 X 7 X 9 inches, and costs about $600. A semi-automatic mounter includes a screen on which each

film image is projected as the film is mounted. One commercial model weighs 253 pounds, has dimensions of 50 X 60 X 29 inches, and costs approximately $5,000.

Reproducing the Film on Aperture Cards

One of the great advantages of machine information systems is that the data can so easily be reproduced for the use of more than one person or agency. Aperture cards can be reproduced by machine, although not as quickly as punched cards. Aperture cards which are pre-mounted with a special diazo film are placed in contact with a "master" aperture card, exposed, and developed. One commercially-produced machine which does this in less than one minute per card weighs 25 pounds, has dimensions of 11 X 11 X 15 inches, and costs approximately $800.

Storing and Retrieving Aperture Cards

Aperture cards should be stored in such a way that they are seldom handled. The most desirable and expeditious system of storage is one which retrieves and projects automatically. A file is being developed which will hold 5,000 cards in units of 100. Any card can be located by means of a four-digit machine "address", retrieved automatically, and positioned in the field of a lens system. No cost figure is available. One very large "elevator" filing cabinet holds 300,000 aperture cards in trays. A given tray can be retrieved in seconds. This file has dimensions of 53 X 101 X 37 inches and costs approximately $6,000.

Projection

The use of an aperture card is through some means of projection. The image can be projected on small or large screens, through standard means of projection or by television. The two systems have different qualities, and their relative costs are vastly different. They will be described separately.

Standard projection

Standard projection has these advantages: it is cheaper than television; it will project color images with the same equipment that projects black-and-white images; and machines have been developed which both show the image and provide a means for printing out a copy of it on photographic paper. Standard projectors for screen viewing (preferably rear-screen viewing) are numerous. A good one should cost $200 to $300.

One viewer which also prints a paper "hard copy" of the image has these specifications. It projects and prints an 18 X 24 inch image, has dimensions of 32 X 31 X 36 inches, weighs 300 pounds, and costs approximately $1,000.

Closed-circuit television projection

The television system is costly, but it has many advantages: film projected in front of a camera lens system can be viewed in a number of different places at once, making a central file a very real possibility; details of the film can be magnified as much as 300 times; more than one film can be projected at the same time and superimposed on the same screen. Although receiver-printers are not yet available, this is simply a technicality which may have been solved before this report is printed.

High resolution closed-circuit television systems are in production and available. It is estimated that the cost of installing closed-circuit television viewing in the Maryland-National Capital Park and Planning Commission offices, with the previously described automatic file, would be $75,000.

CHAPTER 6. SOME IMPLICATIONS OF THE INFORMATION SYSTEM

The introduction of a system such as this will unquestionably have a very considerable impact on a planning operation. This is both expected and desired, and the impact can to some extent be predicted, at least in the following areas:

(1) The introduction of a system like this will foster greater information-gathering cooperation among public agencies. Inevitably, there will be a considerable degree of standardization of information collection methods and procedures, and there will be "pooling" of expensive machine installations. A study of information requirements in metropolitan areas has led many people to the conclusion that some kind of "data center" is necessary. In the Washington metropolitan area a Metropolitan Statistical Project Advisory Panel has been meeting to consider this aspect of the problem. Proper planning for a city requires the utmost coordination among its various planning jurisdictions and agencies, and some sort of centralization of the information process could well provide the basic coordination.

(2) Partially because of the cooperation required for data collection, partially because of the expense of installing an automated system, and partially because the planning process cannot come to a halt while such a system is being introduced, the "installation" of a system such as the one outlined in this report

must be programmed over a period of years. The authors of this report have made some suggestions and recommendations for installing such a system in the Maryland-National Capital Park and Planning Commission which will constitute the final chapter of this report.

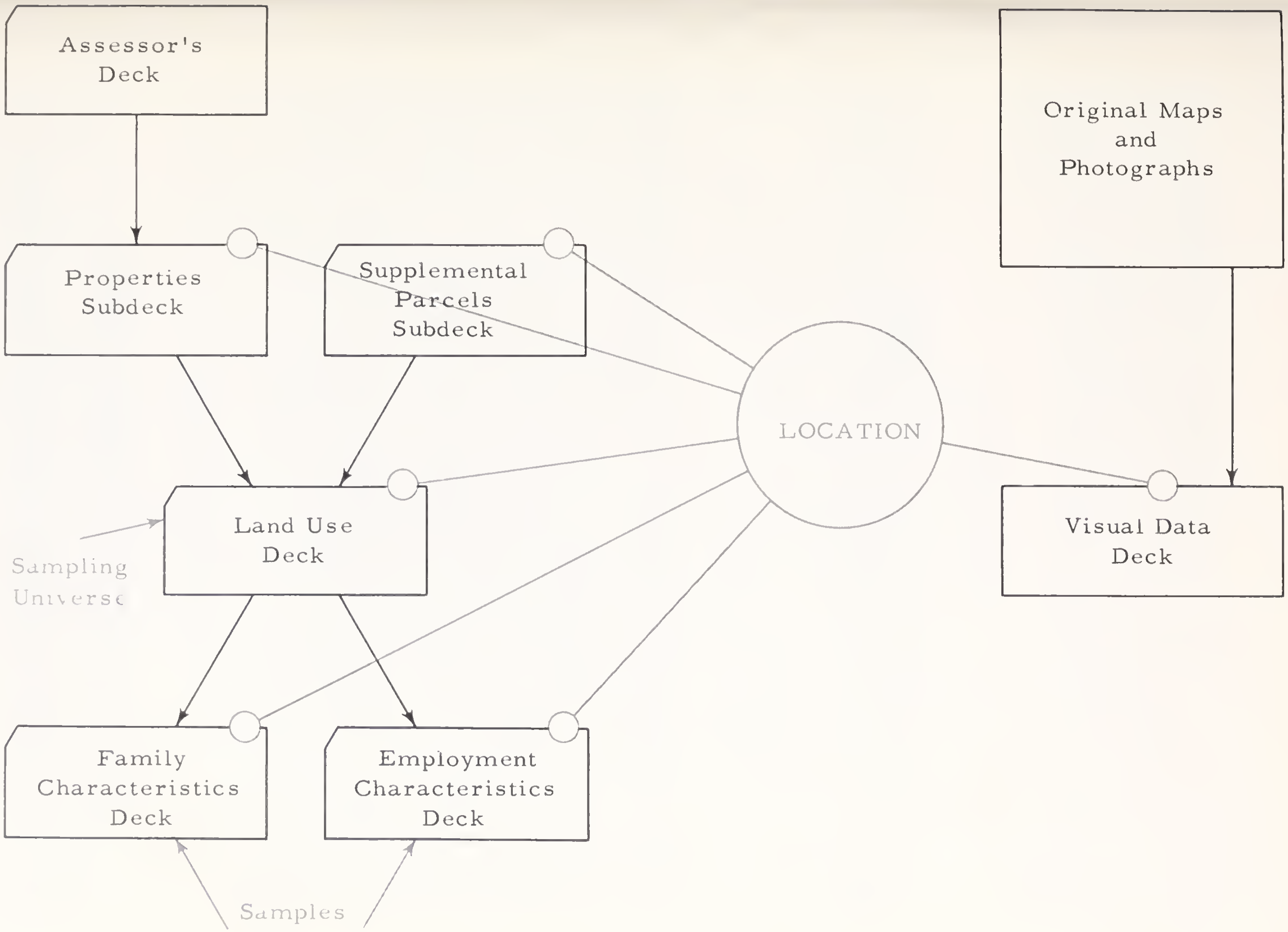
(3) Mention has been made throughout the report of "models". Almost inevitably any process as complex as planning, and particularly any process with great requirements for information, must be organized around some formally structured concepts if it is to become wholly effective. It is therefore impossible to think about information systems for planning without also thinking about the implications such systems have for building models of all sorts, because the systems are "integrated" (Figure 18). The rest of this chapter will be devoted to a general discussion of models for planning.

MODELS DEFINED

A model is simply a representation of something; it is a copy or facsimile. The planner's model is a representation of a place. Place can be represented visually, verbally, or mathematically.

Visual Models

Visual models are organized spatially. A three-dimensional model, a photograph, a map -- each has a specific, statable spatial relationship to the area represented; it is called scale. The meaning of scale (e.g., 1 inch = 400 feet) is this: on this relatively small area of paper (or plaster or plastic) are represented some things which are to be found in a particular place; their locations relative to each other are true, but the distances on this representation are much smaller than they are in the real place; the degree to which they are smaller is stated by the numerical relationship of scale. This model does not contribute a new form of organization. It simplifies the old form by bringing it down to manageable size, by leaving out things, and by overstating things (using bright colors, for example). It does not tell the planner anything new about his city, but it tells him what he



AN INFORMATION SYSTEM FOR URBAN PLANNING

Figure 18

does know in a way that may sharpen his visual appreciation of the order and structure of things in his city. For example, on a three-dimensional model he may substitute a new store building for an old one. On a map he can erase highways and create subways. He can do all of this quite inexpensively and without fear of contradiction. Thus does he use the model to "test" his design.

Verbal Models

Verbal models are organized conceptually. Words cannot show as vividly as can a photograph the arrangement of things in space. Therefore the verbal model tends to emphasize the arrangement of ideas. A verbal model may show, for example, the underlying importance of transportation in a modern city by relating all other aspects of the city to transportation systems. Or a model may show the structure of costs in implementing a plan -- relating cost to specific developments, to ability to pay, and the like -- thereby making possible a more enlightened political decision concerning which portions of the plan to implement and how to go about it. A verbal model simplifies by leaving out the complexities of relative location; it organizes by relating ideas about things. It also permits the planner to "test" his design. He can determine relative costs of alternative designs, or he can postulate various forms of administration, without making any "real" changes. The verbal model does tell the planner something new about his city: it suggests relationships, postulates organization, and permits him to look at old problems in new ways. It is extremely useful. But it is limited by the restrictions of language. Words have connotations and associations. Ideas expressed verbally may be based on assumptions that are unstated, as well as those that are stated and recognized. Verbal models are not rigorous.

Mathematical Models

Mathematical models are organized logically; their language and structure is that of symbolic logic. They can simplify reality to the extent that it is not represented. In fact, this is one of the real virtues of the mathematical model unimpeded by any considerations but those of pure logic. Assumptions are

clearly stated. The organization is rigorous. This structure can then be applied to real situations.

For example, one can say, "Let A represent the average family income in an area, and let B represent the time spent in travel to work by the people in that area." Then the differential equation,

$$\frac{dB}{dA} = k,$$

expresses the relationship between a change in the time spent in travel to work and a change in the family income. It is a small model. The solution of the equation,

$$dB = k\,dA$$

$$B = kA + K,$$

states simply that time spent in travel to work in any area is equal to the average income of the area times the constant k. One must solve for k, and knowing k, one can solve empirically for the additional constant K. The relationships between travel time to work and family income are now expressed explicitly by the two constants, k and K. If the relationships stated in the mathematical model prove useful in relating tangible measurements of the real place, then the nature of those relationships can further be explored mathematically. Because the organization is rigorous, because the relationships can be stated in an exact way, the model can be begun as an over-simplified but completely understood structure, and, if its initial form proves adaptable, expanded in infinite detail without losing the initial advantage of a comprehensible structure. For example, a long and difficult series of equations might represent the relationships involved in a transportation system. But these would relate to the basic equations describing other more general aspects of a city.

MODELS FOR PLANNING

Planners have long made use of visual and verbal models. However, they have not used visual models as effectively in the

past as they will be able to do in the future. New methods of processing visual information (Chapter 5) will do much to facilitate and enhance the use of visual models. Verbal models must be read. They do not communicate ideas as quickly and as clearly as do visual models. On the other hand, they are capable of communicating ideas which cannot be communicated visually. An information system which states facts explicitly, as does this one (Chapter 4), will do much to enhance the verbal models.

Planners have not made much use of mathematical models. Part of the reason for this is that they have not generally had information on hand which would suggest relationships and structures and by which postulated relationships could be examined. In fact, automated information systems and mathematical models go hand in hand; they develop together. Data processing must contribute to, and in turn be based upon, some definite and rigorous structuring of information.

An example of the model-building process as it relates to the information system and to the planning process will perhaps illustrate this point. Assume that one relates number of dwelling units per acre to land use classification. For specified areas of a city, such as arbitrary units identified by the location grid recommended in this report, one totals the number of acres used for each different land use and calculates the density of dwelling units per acre. All of this is done by machine, of course. For each specified part of the city one has the following information:

X_0 = acres used for residential purposes

X_1 = acres used for commercial purposes

X_2 = acres used for industrial purposes

. . .

. . .

. . .

. . .

X_9 = acres unused (in forest, vacant fields, etc.)

X_{10} = dwelling unit density per acre

One can then make the assumption that these variables are linearly related as $a_0x_0 + a_1x_1 + \ldots\ldots + a_{10}x_{10} = 0$ and determine the values of the a's in the equation. (This is a problem in multiple regression analysis, and computer programs already exist for its solution..) One now has a mathematical equation which expresses the relationship between dwelling unit density and land uses for a series of arbitrarily-defined areal units of the city. This equation is a mathematical model of one aspect of the city. If the relationships stated in the model seem to be stable, one can vary the numbers in the model and thus study the effects of changes in one variable upon changes in another. For example, what will be the effect on amounts of land in various uses if the dwelling unit density is increased from p_1 units per acre to p_2 units per acre? Will this necessitate zoning changes?

This rather simple example illustrates an empirical approach to mathematical model building. Given the data in the information system, the model-builder tries to discover significant relationships. He can apply standard statistical techniques to the information at hand with few prior assumptions about what those relationships are.

Models and information systems have the same utility; both help the planner do a better job of improving the city as a proper environment for its citizens.

CHAPTER 7. RECOMMENDATIONS FOR INSTALLING THE INFORMATION SYSTEM

An information system such as the one described in this report cannot be installed overnight. On the other hand, if it is going to be used it ought to be installed in a completely operational sense as quickly as possible. The authors have had the advantage of working closely with Commission staff members and with members of other agencies and offices in the area under the planning jurisdiction of the Maryland-National Capital Park and Planning Commission and feel that they can recommend a program of installation in rather general terms.

VISUAL INFORMATION SYSTEM

Introducing automation and machine methods to the visual materials used by the staff is fortunately neither complicated nor, in terms of the benefits to be derived, expensive. It is recommended that within a year the following steps be taken:

(1) Aerial photographs at 1" = 200' be acquired for the entire planning jurisdiction, and

(2) These and all other visual materials be photographed and mounted on coded aperture cards. Equipment for this step should be bought outright. It is possible that the photographic

processing and mounting can be done commercially, but at a minimum, storage files and viewers are required.

NUMERICAL INFORMATION SYSTEM

While the various elements of the numerical information system will depend ultimately upon the basic information collected by the Assessor's Office, it is presumed that development of a total deck in this fashion will take four to five years which is at present the Assessor's schedule of visits for reassessment. To wait for this process to be completed before being able to make the sample family and employment surveys does not seem reasonable, because these annual surveys will establish the trends that are so badly needed. Therefore, some substitute form of a basic Land Use Deck ought to be developed within the next one or two years so that the entire system can be started. With this concept in mind, the following program is recommended:

(1) The entire deck of Assessor's cards from both Montgomery and Prince George's counties should be duplicated and the duplicates filed in the Commission offices.

(2) A program should be developed for making an initial Properties Subdeck. This program will involve:

(a) Coordinating all available property maps with the grid location system recommended, so that cards from the Assessor's Deck can be located by the proper ten-digit number.

(b) Coordinating the new set of aerial photographs (recommended for the visual information system) with the grid location system, so that all maps and photographs are thus identified.

(c) Adding a land use code to each card from the Assessor's Deck as the location code is added. Land use information should be taken from whatever best sources are available. This includes recent field studies, recent maps in "stable" areas, and the current aerial photographs. From photographs it may only be possible to code Residential (high, medium, and low density), Commercial (structural and non-structural), Public and

Semi-Public, and Open Land. But this will be adequate for sampling for the first family and employment surveys.

(3) The developing Properties Subdeck should receive a periodic input of the new Assessor's cards. Within the first year after the program is put into effect, at least 20% of the Properties Subdeck will be up-to-date in the sense of conforming to the recommended system.

(4) No effort should be made to develop the Supplemental Parcels Subdeck until the basic Properties Deck has been completed.

(5) When the Properties Subdeck has been completed, it should be used as the sampling universe for the two surveys:

(a) The Family Characteristics Deck can be developed from the Properties Subdeck, using cards coded to show single-dwelling and multiple-dwelling residential land use.

(b) The Employment Characteristics Deck can be developed from the Properties Subdeck, using cards coded to show commercial, industrial, transportation, institutional, educational, and public service land uses.

ESTIMATED COSTS

An important aspect of any information system is, of course, the question of expense. The authors have attempted to determine as explicitly as possible the costs of installing such a system for the Maryland-National Capital Park and Planning Commission jurisdiction. Those figures have been supplied the Commission staff. It is obvious that they apply only to that specific jurisdiction and not to information systems in general or to other specific areas.

An important consideration in this aspect of the development of an information system for urban planning is whether or not there is a central data collection and processing organization. A central organization would obviate duplication of effort and simplify and systematize processing; it would thus reduce the cost for individual planning jurisdictions.

American urban agglomerations are so dynamic and complex that instrumentation and automation must be used if the planner is to keep up with the fast pace of metropolitan events. The question of metropolitan administrations is not, in the opinion of the authors, whether or not an information system ought to be adopted, but rather how soon it should be instituted and what should be the magnitude of the effort.

U.S. GOVERNMENT PRINTING OFFICE 1967 O - 256-721

HUD TS-14
MARCH 1967